Ce rapport est aussi disponible en français.

REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE DISAPPEARANCE OF THE CANADIAN LARGE FISHING VESSEL "SCOTIA CAPE" WITH SEVEN CREW MEMBERS, IN THE QUEEN CHARLOTTE SOUND AREA, BRITISH COLUMBIA, ON OR ABOUT JANUARY 29, 1987.

REPORT No. 480

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Particulars of Vessel

Name	"SCOTIA CAPE"
Official Number	328502
Port of Registry	Prince Rupert
Gross Tonnage	390.53
Net Tonnage	189.11
Length Overall	35.97 m
Length BP	29.57 m
Breadth Moulded	8.53 m
Depth Moulded	4.11 m
Draught (estimated at departure)	F: 2.52 m A: 4.56 m
Draught (at time of incident)	Not known
Type - at construction	Combination seiner/trawler
Material of Construction	Steel
Built	Saint John, N.B., 1967
Converted	1971, from seiner to trawler
Propulsion	One Caterpillar D398 diesel engine of 570 kW, driving a single shaft with a fixed pitch propeller in a kort nozzle
Speed	11 knots
Cargo (on departure)	66 tonnes of preservation ice
Crew	Seven, including master
Owners	1) British Columbia Packers Ltd. Richmond, B.C.

2) Foote Fishing Ltd.
Prince Rupert, B.C.

Navigation Equipment

Radiotelephones	Marconi, CH 100, single side-band 2 Apelco VHF 54AS Citizen Band, Maxcom 20 Unimetrics, VHF 55 CH. NDI, VHF 7600
Loran C	LC 80 Koden 768 JNA 760
Track Plotter	JRC, Model NWU-51
Echo Sounders	Simrad EQ (38 kHz) Colour Sounder F201 (50 kHz)
Radars	Decca 916 Furuno FR360
Compass	Magnetic, Sperry, (one steering and one spare)
Automatic Pilot	fitted

Life-Saving Equipment

Lifejackets	11 DOT approved (adult)
Lifebuoys	Four DOT approved, two with lines
Lifeboat	One 4-person, stowed on top of the wheel-house
Immersion Suits	Eight, normally stowed in crew's quarters
Liferaft	One 15-person Dunlop Seafarer SOLAS approved inflatable raft carried in container on upper deck forward of wheel-house.

Description of Vessel

The "SCOTIA CAPE" was originally built as a seiner/trawler but was modified in 1971 and operated as a trawler thereafter.

The ship was sub-divided into compartments by eight transverse watertight bulkheads, all extending to the main deck. The compartments, from forward, were the fore peak tank, fuel tank, cofferdam, Nos. 1 and 2 fish holds, engine-room, fresh water tank, rope store and aft peak oil fuel transfer tank.

The wheel-house was amidships with two fish holds beneath and forward of the wheel-house and the engine-room aft. (See Annex 7)

The vessel was well equipped with electronic navigational equipment, all of which was in apparent good working condition upon departure.

An annual inspection was carried out by the Ship Safety Branch of the Canadian Coast Guard, September 23, 1986 and Inspection Certificate SIC 31 was issued with an expiry date of May 24, 1987. This certificate was valid subject to the adherence to a rider clause contained therein (See Analysis 4).

Note: 1. All times in this report are expressed in Pacific Standard Time (UTC minus 8 hours).

2. A glossary of abbreviations and terms can be found following the Findings in the report.

Background

On January 27, 1987, the large fishing vessel "SCOTIA CAPE" departed the B.C. Packers Ltd., unloading wharf in Steveston, B.C., at approximately 2300, bound for the fishing grounds of the Queen Charlotte Sound, British Columbia.

On board were seven crew members, all well experienced fishermen and, although bad weather was forecast for the next few days, there was no mention to anyone ashore of altering their fishing plans.

The "SCOTIA CAPE" was last seen westbound by the fishing vessel "ARCTIC HARVESTER" at approximately 2020, January 28 while passing Bull Harbour in Goletas channel.

Gale force south-easterly winds were blowing over most

of the West Coast from January 27 and gale warnings were upgraded to storm warnings January 29 until February 5, 1987.

When the vessel failed to make a scheduled radio call February 5, the owners started to make inquiries and reported the vessel missing, February 6. An extensive search failed to find any evidence of the missing vessel. The "SCOTIA CAPE" was insured for some $1,200,000 and is considered a total loss.

Persons Missing

Name	Vagn Mark
Position aboard	Master
Age	47
Address	Prince Rupert, B.C.
Name	Roger Foote
Position aboard	Mate
Age	45
Address	Prince Rupert, B.C.
Name	Ken Abbott
Position aboard	Engineer
Age	44
Address	Surrey, B.C.
Name	Tad Cimoszko
Position aboard	Deck-hand
Age	32
Address	Surrey, B.C.
Name	Albert Barnes
Position aboard	Deck-hand
Age	43
Address	Vancouver, B.C.
Name	Bruce MacDonald
Position aboard	Deck-hand
Age	28
Address	Richmond, B.C.
Name	Roxy Stove
Position aboard	Cook
Age	33
Address	Nanaimo, B.C.

Narrative

After having unloaded the previous trip's catch of

groundfish, the "SCOTIA CAPE" loaded 66 tonnes of shaved ice into her fish holds and with a usual load of diesel fuel and fresh water, she departed the B.C. Packers unloading dock in Steveston on the Fraser River, B.C., at approximately 2300 January 27, 1987 for another fishing trip.

The exact location of their destination was known only to the master as fishing is a very competitive enterprise and secrecy about good fishing grounds is considered paramount. However, it was known that they intended to fish in the general area of Queen Charlotte Sound/Hecate Strait.

The "SCOTIA CAPE" had communicated by radiotelephone with the fishing vessel "CARMANAH" during January 28, and the two vessels had passed each other on reciprocal courses before dark when approximately abeam of Port Hardy; in the exchange, all appeared well aboard the "SCOTIA CAPE".

During the evening of January 28, the trawler "ARCTIC HARVESTER" was returning from the fishing grounds and was abeam of Bull Harbour while eastbound at approximately 2020, when she passed the "SCOTIA CAPE" which was westbound. The master of the "ARCTIC HARVESTER" recognized the shape and lights of the "SCOTIA CAPE" as the vessel was a familiar sight on the coast for trawlermen; there was no radio communication between the vessels.

The weather, at the time of passing off Bull Harbour, was relatively good with moderate south-easterly winds, but during that night, the "ARCTIC HARVESTER" reported winds of 70 knots in Johnstone Strait.

After this last sighting of the "SCOTIA CAPE", westbound in Goletas channel, no word nor any sign was ever heard or seen of the vessel again except for an unconfirmed radio transmission from the "SCOTIA CAPE" to Bull Harbour radio station on the morning of January 31.

The "SCOTIA CAPE" was scheduled to contact B.C. Packers Ltd., through B.C. Telephone marine radio system by February 5 at the latest, and after still not having heard from the ship February 6, B.C. Packers, in turn, tried to contact her through B.C. Telephone and also requested other vessels in the area to call the "SCOTIA CAPE" using their marine radiotelephones. When no answer was received and the vessel was reported as not having been seen or heard from, the company and the son of the master of the "SCOTIA CAPE" reported to the Rescue Co-ordination Centre (RCC) in Victoria, that the vessel had failed to make a scheduled reporting call; the report to RCC was made in the afternoon of February 6. A General Marine Broadcast (GMB) was issued a

short time later that same afternoon.

An extensive Search and Rescue (SAR) operation involving 20 aircraft, 4 Coast Guard vessels and one DFO vessel commenced on February 6 and the full-scale search of the large search area continued for 11 days but no identifiable trace of the fishing vessel was found. After reviewing the overall SAR operations, RCC placed the search on 'reduced' status on February 17 and the case was handed over to the RCMP as the 'missing person' case. During this period, a number of private vessels also carried out their own search.

Gale and storm force winds from the south-east to south-west were reported throughout the entire period until February 6 when the search was initiated by RCC Victoria.

At the time of writing this report, no debris nor fuel oil has been found that could be identified as originating from the "SCOTIA CAPE".

Analysis

1. **The Vessel**

At the time of the casualty, the fishing vessel "SCOTIA CAPE" was employed as a single screw stern trawler having been built in 1967 by Saint John Shipbuilding and Dry Dock Co., of Saint John, New Brunswick as a combination seiner/trawler. The vessel was of all welded steel construction and was fitted with bilge keels port and starboard.

She had two decks, the uppermost continuous being the main deck which extended to the middle of the stern ramp. Forward of amidships on that deck was the crew accommodation while the aft section had the main winch, used for trawling, situated immediately forward of the stern ramp and on the fore and aft centreline. In line with the lower end of the stern ramp and on both sides were two raised gallows approximately 5 m in height with openings and blocks through which the dragging warps from the main winch passed. Two trawl doors were kept secured to these gallows when the vessel was not fishing. On top of the port side gallows was what was called a 'yoyo crane' or a 'cod end derrick'. On the port and starboard sides were watertight doors (one on each side) leading to the crew accommodation with access stairways to the upper deck. In the middle of the accommodation section were two hatches giving access to the fish holds. Immediately forward of the main winch was a fish sorting box with a conveyor belt to bring the

fish to the hold hatches.

The underdeck compartments located on the floor line, were framed and numbered from 0 at the stern post to 62 at the bow for a distance of 32.3 metres. Nos. 1 and 2 fish holds extended from frames 23 to 44 (10 m); forward of No. 1 hold was a cofferdam and the forward fuel tank extended from frames 46 to 52. Forward of the fuel tank was the forepeak tank.

Aft of the fish holds was the engine-room from frames 8 to 23 (7.4 m), the fresh water tank of 19 tonnes capacity was located aft of the engine-room and aft of the fresh water tank were the rope store, steering gear compartment and the aft peak oil fuel transfer tank.

Forward of amidships on the upper deck and immediately forward of the samson post was a net stowage drum and on either side of this drum was clear deck space for trawl gear. Forward of the drum were a deck store and a CO_2 room. Forward of the superstructure and at the centre-line were fish hatches and immediately forward, at frame 40, was a small deck-house, 2.4 m by 1.5 m, enclosing a store-room on the port side, a ventilation room on the starboard side and a stairway on the centreline giving access to the main deck.

Aft of amidships was a watertight hydraulic fish filling trap 2.7 m wide by 1.5 m which, when closed, was flush with the deck and when open, gave access to a fish chute by which means, the catch was sent to the fish sorting pens on the main deck from where it would be conveyed to the fish hold hatches to be stowed and iced in pens. Immediately aft of the fish trap was a ramp and a wave trap extending from frame 4 to frame -5. When closed, the wave trap would be flush with the ramp allowing the net to be hoisted on to the upper deck. The width of the ramp and trap was 3.5 m and the ramp length, 5.5 m. The after end of the wave trap would be approximately 0.5 m above the load waterline and would extend to 2.5 metres.

On the main deck, one freeing port measuring approximately 0.9 m x 0.45 m and fitted with vertical bars and hinged flaps, was arranged in each of the port and starboard bulwarks between frames 3 and 5.

Access from the main deck to below was through water-tight doors, one each on the port and starboard sides of an athwartship bulkhead at frame 10. These doors led into the fish sorting compartment from where a conveyor

belt, slightly to port of the centreline, would carry the fish to the holds. On the port side next to the aft door was the engine casing. At the forward end of this compartment on the starboard side was the entrance to the accommodation.

On the upper deck, bulwarks approximately 0.7 m high at the break between the wave trap door and the ramp, extended forward along the ship's sides to abreast the fish holds hatch coaming at frame 38.

On the bridge deck were the wheel-house and the captain's quarters. The steering wheel was amidships, the chart table on the port side and on the starboard side aft of the wheel-house were the winch controls for the main winch. The main winch could also be controlled from the main deck. The electronic fish-finding equipment was also located on the starboard side of the wheel-house.

On the wheel-house top, aft, were two 'Gearmatic' winches used for hoisting the cod end. Wire runners were passed through two blocks made fast to the main mast, at an approximate height of 2.1 m, and of sufficient length to reach the ramp on the upper deck. The winches were controlled from the upper deck.

The inflatable liferaft was carried on the starboard side of the deck-house on the upper deck forward of the wheel-house. It was stowed on chocks and was secured to the deck with a senhouse slip. No hydrostatic release was fitted to the raft and the vessel was not equipped with an EPIRB.

2. Weather forecast

A warning was issued by Environment Canada at 0105, Wednesday, January 28, 1987 for Johnstone and Queen Charlotte Straits for storm force winds of 50 to 70 knots, easing to gale force and then moderate to strong later.

This forecast was proven correct by virtue of the "ARCTIC HARVESTER" reporting winds of 70 knots while in Johnstone Strait during the early morning of January 29.

A revised marine forecast for B.C. coastal waters issued by Environment Canada at 1315, Wednesday, January 28, upgraded a gale warning to storm warning for Queen Charlotte and Johnstone straits:

> East to south-east winds, gales 40 to storm force 50 knots rising at times to 70 over Queen Charlotte Strait. Winds easing to 30 to gales 40 early this morning and to 20 to 30 late in the morning. Winds easing to south-easterly 20 Wednesday afternoon.

At 1645, January 28, the marine forecast for B.C. coastal waters issued by Environment Canada posted storm warnings for Queen Charlotte Strait, Johnstone Strait and for the West Coast of Vancouver Island, northern section.

Easterly gales were forecast for Queen Charlotte Sound and variable winds for Hecate Strait becoming south-easterly 15-20 knots overnight.

At 0445, Thursday, January 29, the marine forecast for B.C. coastal waters issued by Environment Canada maintained the storm warnings previously mentioned and continued the gale warning for Queen Charlotte Sound and the West Coast Charlottes and issued a gale warning for Hecate Strait with winds from the south-east becoming east to north-east in the afternoon and shifting to the south-west overnight.

By 2245, Thursday, January 29, storm warnings were issued by Environment Canada for Queen Charlotte Sound and Hecate Strait for south-easterly winds to 60 knots. At 0445, Friday, January 30, Environment Canada upgraded the gale warnings for the West Coast Charlottes to a storm warning with south-easterly winds to 55 knots.

The marine forecast for B.C. coastal waters issued by Environment Canada at 0445, Saturday, January 31:

> Queen Charlotte Sound
> Hecate Strait
> Dixon Entrance
> Storm warnings downgraded to gale warnings. Winds south to south-west 20 to 30 knots becoming south-east 25 to gales 35 this evening. Showers reducing the visibility to 3 miles.
> Outlook, strong to gale force south-easterly winds.

These gale warnings were maintained until the marine forecast of 1645, Monday, February 2, 1987 when they were upgraded to storm warnings for south-easterly winds

to 60 knots. At 0445, February 5, 1987, south-easterly winds of 55 to 70 knots were forecast.

The marine forecast for B.C. coastal waters issued by Environment Canada at 1045, Thursday, February 5, 1987 downgraded the storm warning to gale warning in the west portion of Queen Charlotte Sound, Hecate Strait and the West Coast Charlottes. South and south-easterly gale force winds were forecast.

The gale warning for Queen Charlotte Sound was ended with the marine forecast of Environment Canada issued at 2245, Thursday, February 5, 1987, but at 0250, Friday, February 6, 1987 a gale warning was issued by Environment Canada for Queen Charlotte Sound and Queen Charlotte Strait for south-easterly winds to 35 knots.

The marine forecast for B.C. coastal waters issued by Environment Canada at 1045, Friday 6, 1987 ended the gale warnings for Queen Charlotte Sound, Hecate Strait, Dixon Entrance and the West Coast Charlottes.

Annex 1 gives the daily weather conditions as reported at five locations in Queen Charlotte Sound and Hecate Strait and although the whole area was battered by gale and storm force winds from January 28 to February 5, the worst weather conditions were experienced at Cape St. James. At this station, winds gusted to 74 knots, January 30 but local mariners advise that 15 to 20 knots should be added to that wind velocity to obtain a more accurate reading in open waters; waves on that day were averaging 8 m in height by the evening.

3. Tides and currents

The Sailing Directions for the north portion of the British Columbia Coast, state that the tidal stream flood and ebb into and out of Sounds, Straits and Inlets leading off Queen Charlotte Sound and Dixon Entrance. The flood entering Dixon Entrance along the north shore of the Queen Charlotte Islands splits, with part heading north into the Alaskan channels and part turning south into Hecate Strait. Similarly the flood stream entering Queen Charlotte Sound enters the channels and inlets along the coast, and part turns north into Hecate Strait meeting the flood from Dixon Entrance at about latitude 53°15'N.

The tidal information for Queen Charlotte Sound and Hecate Strait is referenced on Bella Bella. Over the period the "SCOTIA CAPE" was last seen until the time

that she was reported missing, the largest tides occurred during the last three days of January with tidal ranges of 5 metres.

The local weather reports show storm force south-easterly winds gusting to 74 knots at Cape St. James, January 30. These winds blowing against a 5 m ebb tide, would considerably increase the size of waves in this area.

The average rate of tidal current is 1.5 knots for the Queen Charlotte Sound and Hecate Strait. Quoting from the Sailing Directions for Queen Charlotte Sound and the south portion of Hecate Strait (see Annex 3) under "Tidal streams and currents":

> About sixteen hours after the passage of a storm through the sound, and where the wind veers from south-east to south-west to north-west, the maximum currents will occur about 3.5 hours after high water at Prince Rupert, and may remain out of phase for three or four days. The initial change of phase is usually accompanied by a surge of current about 0.5 knots greater than is usual. This change in the phase of the current is caused by a wind driven inertial current of period 15.4 hours and a starting velocity of 0.6 kn. This current slowly decays over a three- to four-day period.

In continuation of the chapter, the following paragraph is noted under the title "Caution".

> Caution - During a period of calm weather in 1968 an oil rig, drilling in 52°N, 130°W, experienced unusual currents of 2 to 3 knots setting south. Such a strong outflow from Hecate Strait can occur when the tidal range is large and the barometric pressure difference between the coast and an inland high pressure area drops more than 7 millibars in one day. It was reported during a gale that this oil rig experienced a wave with a height of 27.5 to 30 metres.

A storm moved through Queen Charlotte Sound between 2200 and 0400, January 29 and 30 followed by a short period of westerly winds and then very strong south-easterly

winds which preceded the next storm.

From the Sailing Directions, it can be deduced that the currents might have moved out of phase and were accompanied by a surge of current about 0.5 knots greater than usual.

Between 1000, January 29 and 1100, January 30, there was an 11 millibars change in the pressure gradient between the coast and an inland high pressure area, as confirmed by the Atmospheric Environment Service in Vancouver. Hence, unusual currents could be expected during the afternoon of January 30. The velocity of these currents cannot be precisely determined, but if currents of up to 3 knots were experienced in the south end of Hecate Strait, then at least this velocity was met in Queen Charlotte Sound as all the conditions were favourable for a much greater current than usual.

4. Certificates

The "SCOTIA CAPE" was required to be inspected annually and held a valid Inspection Certificate, issued by the Ship Safety Branch of the Canadian Coast Guard, due to expire May 24, 1987. The vessel was certificated for Home Trade Class II waters.

The validity of the SIC 31 issued to the "SCOTIA CAPE" September 23, 1986 was subject to the following limitation: (See Annex 2).

> As above and subject to the accepted conditions of loading contained in the owners stability document being adhered to.

It was reported that the SIC 31 was posted in the wheelhouse of the vessel.

No such limitation was appended to the SIC 31 Certificates until May 1984. In this instance, the vessel was inspected by the Ship Safety surveyors based in New Westminster, and this particular office has a local policy that all inspection certificates, applicable to vessels having a stability booklet, are automatically subject to this clause. In other words the SIC 31 Certificate aboard the "SCOTIA CAPE" was claused as a matter of local routine, not because of any change in the vessel's stability characteristics. The Certificate issued in May 1985, valid for one year, contained no such clause as it was issued from the Vancouver Ship Safety Office.

The SIC 31 Certificate dated September 1986, and on board the vessel at the time she was lost, was similarly claused because it was, again, issued by the New Westminster office.

No explanation was requested by the owners or the crew, regarding the reason for the additional clause on the SIC 31 certificate, and no explanation was offered by the surveyors.

No SIC 31 Certificates have been traced, to cover the period December 1980 to April 1982, i.e. the second year of the vessel's operation on the West Coast, nor has any record been found in the Ship Safety computerised record system for this period. It can only, therefore, be assumed that the vessel was operating without the required inspections throughout that time.

Under the Canada Shipping Act, the "SCOTIA CAPE" was required to have a licenced master and her master held a valid Fishing Master Certificate for the trade in which she was employed. The engineer was not certificated nor was he required to be by regulation.

Under the Ship Station Radio Regulations made pursuant to the Canada Shipping Act, the "SCOTIA CAPE" held a valid Radio Inspection Certificate due to expire March 17, 1987, and her master held a valid Restricted Radiotelephone Operator's Certificate as required by the General Radio Regulations. This radio equipment included a manually operated two-tone auto alarm generator.

5. **General history and condition of the vessel**

In 1979, ultrasonic tests were carried out in Dartmouth, N.S., to determine the shell plate thicknesses between frames 23 and 43.

Following the stranding of the vessel in 1985, at Rippon Point, B.C., extensive repairs were carried out to her hull at B.C. Marine Shipbuilders, Vancouver, B.C.

Other than the necessary rearrangement of fishing equipment for the conversion from seining to trawling operation, there was no reported significant structural change to her hull, machinery or ventilation ducting since her launching in 1967, and only a minor extension of the superstructure.

When the vessel was completed and entered service in 1967, as a combination seiner/trawler, she was primarily

outfitted and rigged for operation as a seiner, and consequently the lightship weight incorporated in the approved Trim and Stability Booklet included the seine fishing gear and spares. In order to determine the condition of the vessel at the time of the casualty, the following recorded changes and relocations of fishing gear etc., were made when deriving her current lightship as equipped for trawling operations in 1987;

Lightship (as built) 1967	=	378.26 tonnes
Items removed at 1971, refit	=	(-) 6.91 tonnes
Items added 1971, refit	=	(+) 8.13 tonnes
Original seining outfit removed	=	(-) 11.44 tonnes
Current trawling outfit added	=	(+) 10.77 tonnes
Dory and davit removed	=	(-) 0.91 tonnes
Lightship Weight (at casualty) 1987	=	377.90 tonnes

6. Description of machinery space

Main Engine

Engine Builders	Caterpillar
Model	D 398
Number of cylinders	12 V
Bore	155 mm (6.25 in)
Stroke	203 mm (8.00 in)
RPM	1225
HP	765 (570 kW)

The engine, located between frames 12 and 20, was water cooled through an internally fitted heat exchanger.

The engine drove a single fixed-pitch propeller through a single reduction reverse gear (3.95:1) Twin Disc model 3192. It also drove, from the front end, a power take-off to supply the hydraulic trawl winch.

The main engine and the trawl winch were pneumatically controlled.

The main engine was air-started but the auxiliary engines were electric-started.

Auxiliary engines

Port side:

Engine Builders	Caterpillar diesel
Model	D 330
Number of cylinders	4
Bore	114 mm (4.5 in)
Stroke	140 mm (5.5 in)
HP	91.5 (68 kW)

It was water cooled through an internally fitted heat exchanger and drove an AC electric generator, details of which were:

Builders	Tamper
kW	55
Volts	220/110
Phases	3
Cycles	60
KVA	68.8

Starboard side:

Engine Builders	Caterpillar diesel
Model	D 343
Number	6
Bore	137 mm (5.4 in)
Stroke	165 mm (6.5 in)
HP	245 (183 kW)

It was water cooled through an internally fitted heat exchanger and drove an AC electric generator identical to that on the port side. It also drove a power take-off to supply the trawl winch.

Main and auxiliary engines were last overhauled by a contractor in 1986.

Switchboard

The switchboard was located forward on the starboard side of the engine-room upper level. It was built by E.S. Stephenson & Co., Saint John, N.B., and Halifax, N.S.

Megger testing of the primary electrical circuits of the vessel was carried out 1986, and found to be satisfactory.

Alarms

A bilge high-water-level float was situated in the after part of the engine-room bilges near the tail shaft. It was electrically connected to alarm panels in the engine-room and wheel-house.

Both panels were identical and displayed the following warning lights plus an audible alarm:

Main engine alarms: Gear oil pressure, fresh water pressure, starting air pressure, control air, low oil pressure, fuel supply pressure and engine overload.

Aux. alarms: Low fuel level, bilges high level.

Aux. engine No. 1: Low oil pressure, high water temperature.

Aux. engine No. 2: Low oil pressure, high water temperature.

The wheel-house alarm panel also displayed the following light signals: fuel oil transfer pump, fire and general service pump, air compressor, fish wash pump, engine-room supply fan, steering-motor running and winch power on.

It was reported that these panels were rewired in 1986.

Tanks

The forward fuel tank, with a capacity of 29.3 tonnes (7,600 gal), the fresh water tank located between frames 6 and 8, with a capacity of 19 tonnes (4,200 gal) and the after peak fuel oil transfer tank all extended across the width of the vessel. The original construction plans indicated that the forward fuel tank and the

bulkhead on the centreline. The fact that such a perforated bulkhead was fitted in the forward fuel tank was confirmed by a witness who had been previously employed as an engineer aboard the "SCOTIA CAPE".

There was a fuel oil wing tank on the starboard side of the engine-room and a lubricating oil storage tank, hydraulic oil tank and a fuel oil daily supply tank on the port side. The total volume of the three tanks on the port side was equal to that of the starboard fuel oil wing tank.

7. **Fuel oil transfer procedure**

It was reported that on some occasions, the vessel had departed for the fishing grounds with her forward fuel oil tank full and a depth of about 2 m (6.56 ft) in the after peak fuel oil transfer tank.

The procedure on transferring the fuel oil was not standardized and would differ depending on different operating requirements. There were no permanent orders to the engineer on the subject. It has been reported that normally the procedure was to transfer fuel from the after peak tank first because the vessel had a trim by the stern at the beginning of the voyage. Later, as the fish holds were being filled, they would begin to use fuel from the forward fuel oil tank. Occasionally in order to correct list and/or trim of the vessel, fuel would be transferred to or from the starboard fuel wing tank. In these circumstances, shortly after arrival at the fishing ground, all the ship's tanks would be slack, and the vessel would then be subjected to their cumulative free-surface effects.

8. **Safety equipment**

The life-saving appliances on the "SCOTIA CAPE" consisted of one lifeboat of 4-person capacity carried on top of the wheel-house, one 15-person inflatable liferaft carried forward of the wheel-house on the upper deck, four lifebuoys, eleven lifejackets and eight immersion suits. The immersion suits were reportedly stowed in the crew's quarters. It was reported that the lifebuoys were retained in their brackets with rope lashings using a slip knot and that owing to heavy weather conditions expected, all floatable items on deck would have been lashed.

In 1979, when the "SCOTIA BAY", a sister ship to the "SCOTIA CAPE", capsized and foundered, the inflatable

"SCOTIA CAPE", capsized and foundered, the inflatable liferaft was stowed on top of the wheel-house and in the process of lowering it to launch it in the water, one crew member had his arm broken when the raft fell on him. This may explain why a decision was made to restow the liferaft on the upper deck of the "SCOTIA CAPE".

It was reported that on previous voyages, two 15-person liferafts had been carried on the "SCOTIA CAPE", stowed each side of the deck-house. During their annual inspection in June 1986, one liferaft was condemned and was neither repacked nor replaced. No record could be found of any other liferaft having been purchased by or loaned to the "SCOTIA CAPE" and it must therefore be assumed that only one liferaft was carried.

However, the vessel still met the applicable Section of the Large Fishing Vessel Inspection Regulations with the carriage of only one liferaft.

No hydrostatic release was fitted to the liferaft lashings and the vessel was not required to be so fitted under the present regulations. There seems to be a widely held belief that hydrostatic releases are not suitable for smaller ships due to the large amount of water that could be shipped on deck in rough weather which, it was felt, may trigger the hydrostatic release and the resultant loss of the liferaft.

9. Loss of sister ship "SCOTIA BAY"

On September 6, 1979, in Dixon Entrance, Northern B.C. waters with the mate now currently lost with the "SCOTIA CAPE" then in command, the "SCOTIA BAY" brought a large haul of fish on deck, and then slowly heeled over and sank. The "SCOTIA BAY" was one of four sister ships, which included the "SCOTIA CAPE".

The "SCOTIA BAY" had reportedly caught some 36,000 kg (80,000 lb) of hake off the Queen Charlotte Islands and then moved back to Dixon Entrance to fish for turbot. Weather conditions were poor with the wind SE'ly 25 knots and a rough sea with a moderate swell, and the vessel heading in a NE'ly direction across the swell. A heavy haul of fish was made, estimated at some 18,000 kg (40,000 lb) and the net full of fish was being hauled on deck. A wave ran up the ramp and filled the fish pounds on deck. The net full of fish slid to the starboard side of the upper deck and the vessel slowly heeled over to starboard, downflooded and sank. The crew of seven took to the liferaft, after making a 'MAYDAY' R/T call,

and were safely picked up, although one crew member suffered a broken arm. The vessel was not salvaged and was a total loss.

A Preliminary Inquiry under the CSA was ordered but in that era, Inquiry reports were considered privileged information for the Minister and not released. The owners of the "SCOTIA BAY" and co-owners of the "SCOTIA CAPE" were, therefore, not directly aware of the Preliminary Inquiry report findings, which were:

"Conclusion

> It is the opinion of the undersigned that this vessel capsized and foundered, probably due to a lack of stability caused by an accumulation of top weights and a maximum of free surface in slack tanks and the fish pound."

Following the recent loss of the "SCOTIA CAPE", the stability of the "SCOTIA BAY" just prior to her capsize was calculated and was found to be significantly lower than the minimum requirement of STAB 4. The capsizing was therefore readily explained and the opinion of the investigating officer at the time, confirmed. However, it must be emphasised that for some 8 years since the loss of the "SCOTIA BAY", the "SCOTIA CAPE" had successfully fished in all types of weather in the same general areas without apparent incident.

The Preliminary Inquiry was carried out by an officer of the Marine Casualty Investigation Unit, then a division of the Canadian Coast Guard, and he made these recommmendations on November 14, 1979, separate from his report, as was the policy:

"Recommendations

1. It is recommended that the stability for this vessel be reworked to determine if the additional weights and loss of GM due to free surface did, in fact, cause this vessel to capsize. There are, I believe, three sister ships to this vessel and a similar set of circumstances could occur to them.

2. The stipulation in the stability book concerning the sequence of emptying the fuel tanks should be drawn to the attention of the operators of the other owners, if the same stipulation is included in their stability

books."

There is evidence that these recommendations were approved in Ottawa and that it was requested that they were to be passed locally by the Investigator to the Ship Safety office in Vancouver. There is no written evidence that these recommendations were passed in this way although it was standard practice for the Investigator to discuss and request that such action be taken with the appropriate Senior Regional officers of Coast Guard. All the key players in the affair have since left the Service and none can recall the details concerned.

10. Trawling

As the "SCOTIA CAPE" was a stern trawler, the trawl was deployed from the stern and could reach a depth of 200 fathoms with the towing being carried out at a speed of approximately 3 knots along a precise depth contour line, regardless of the direction of the wind or sea. The "SCOTIA CAPE" reportedly had fished in winds of up to 60 knots with waves to 4 m without having previously endangered the vessel or the fishing gear. The catches of fish normally taken included most species of groundfish, i.e. Pacific Ocean perch, yellowmouth, rougheye, canary and silvergray rockfish, lingcod, pacific cod and the rock and dover soles. The areas normally fished by the "SCOTIA CAPE" were Hecate Strait, Queen Charlotte Sound from the north end of Vancouver Island to Cape St. James, and the West Coast of the Queen Charlotte Islands up to and including Dixon Entrance.

There is a certain reluctance by fishermen, when the fishing is good, to attract attention to themselves so as not to disclose their location and this is especially true of far ranging trawlers. This factor leaves a very large area of water where the "SCOTIA CAPE" could have been fishing but from the opinion of local fishingmasters who knew the missing master, the area south of Hecate Strait between Cape St. James and Cape Scott seems most likely to have been the area of operation for her last voyage.

A normal haul of fish taken by the "SCOTIA CAPE" would be around 20 tonnes and a good haul at around 30 tonnes. The net full of fish is winched up the stern ramp of the vessel and the wires from the 'Gearmatic' winches are then hooked, one at the forward end of the bag or net and the other to the splitting strap. The catch is then hoisted on the upper deck where the net is opened. The

total fish hold capacity of the "SCOTIA CAPE" was 180 tonnes of fish and preservation ice.

It was reported that on the "SCOTIA CAPE" up to 35 or 40 tonnes of fish had been taken at times and on these occasions, when working in moderate to rough seas, the very heavy load of the catch and the extra time taken to bring the net on board caused following seas to run up the ramp of the vessel, spilling on the upper deck where crew members worked in waist-deep water until the water cleared itself from the upper and main decks through the ship's side freeing ports and scuppers. These conditions were similar to those involved in the loss of the sistership. In these instances, the stability would have been further greatly reduced due to the weight and free surface effect of the water on the decks of the vessel.

Because the "SCOTIA CAPE" always managed to ride these critical moments well, she was thought to be able to withstand almost any weather that could be encountered at sea. The crew who sailed on the vessel had supreme faith in the vessel's ability to continue fishing in adverse weather and this was a factor in the crew's acknowledged high earning capacity. An explanation as to how the vessel had survived eight years of such fishing operation is that, probably, previous conditions were such that she managed to place at least a partial load of fish down below, before meeting any extreme weather. Consequently, her transverse stability was then sufficient to absorb these adverse effects and ensure her safety.

11. The reporting system

The fishing vessels, either owned or working for B.C. Packers Ltd., do not report their positions or other pertinent information to their office on a regular basis. Such omission of scheduled information is typical throughout much of the industry. On the other hand, in other parts of the world, some companies do have a regular radiotelephone schedule which either includes a position 'in code' or simply reports the vessel's condition, deliberately omitting position for 'fishing security'.

12. Position reporting

The 'Manual of Safety and Health for Fishermen' published by the Canadian Coast Guard is based on the International Maritime Organization (IMO) 'Code of

Safety for Fishermen and Fishing Vessels, Part A' and in the manual, under Chapter 2 titled 'Navigation' the following is extracted under the heading 'Position Reporting':

> Whenever possible position reports should be sent to an appropriate Coast Guard radio station at not more than 24 hour intervals, so that in the event of any mishap, the last known position of the vessel can be fixed with reasonable accuracy.
>
> In cases where vessels do not have radio facilities or in cases of radio failure, the skipper should, whenever possible, pass his position to a nearby vessel with radio facilities so that the report may be forwarded as in above.
>
> In all cases the skipper should inform the harbour master or other responsible person of their departure from port, the proposed area of fishing and the approximate duration of the voyage. They should notify the same person of their return to port.

The above are recommendations only and are designed to assist the fishermen in case of mishap. It is at the discretion of the master to follow them and on board the "SCOTIA CAPE", as on most west coast trawlers, no position reports were sent and even radio conversations with other fishing vessels are mainly kept to a minimum.

There was a scheduled radio call pre-arranged between the Company and the "SCOTIA CAPE", for the purpose of giving an estimated time of arrival at the Company's dock and the approximate amount and species of fish the vessel would be unloading. In this instance a gap of nine days was to lapse between the day of departure and the day of the intended scheduled call.

The "SCOTIA CAPE" was scheduled to make a radio call to B.C. Packers Ltd., either February 3 or February 5, as an approximate notice of 4 days was normally given before her estimated time of arrival at Steveston.

When no radio calls were received by February 6, the officials at B.C. Packers requested other company fishing vessels in the area to try to make radio contact with the "SCOTIA CAPE" while they themselves tried to call the vessel through B.C. Telephone Marine service

facilities. By late afternoon, as no radio contact had been made with the vessel, officials at B.C. Packers Ltd., reported to the Rescue Co-Ordination Centre in Victoria that the dragger "SCOTIA CAPE" had failed to make a scheduled radio contact and that she could not be raised by any means.

The crew of the "SCOTIA CAPE" was reported to have always made the scheduled radio call with B.C. Packers Ltd., thus giving rise in this case to the concern that something untoward may have happened.

13. **Last visual contact with the vessel**

The master of the fishing vessel "ARCTIC HARVESTER" is reported to have been the last person to have seen the "SCOTIA CAPE" when the two ships passed at approximately 2020, February 28, off Bull Harbour in Goletas Channel. It was dark at the time but the master of the "ARCTIC HARVESTER", who is familiar with the shape of the "SCOTIA CAPE", recognized her as they passed at a distance of about one half mile. Previous to this sighting, the "SCOTIA CAPE" had been in radio contact with the fishing vessel "CARMANAH" whilst off Port Hardy, a conversation heard by the "ARCTIC HARVESTER" while inbound, and this latter vessel expected to see and in fact, did see the "SCOTIA CAPE" about two hours later.

14. **Reported radio calls**

A logger working from a small tug in Smith Inlet reported to RCC Victoria on February 10, that he had heard a radio call on channel 16 VHF from the "SCOTIA CAPE" some time between 1045 and 1050, January 31. The voice reportedly sounded panicky and the message as quoted was: "Bull Harbour, Bull Harbour, this is the "SCOTIA CAPE"." The logger then went ashore leaving his deck-hand on the tug. Some time later the deck-hand heard the same voice calling "Bull Harbour, Bull Harbour".

The deck-hand could not be located for interview and subsequent inquiries from other shipping and at radio stations in the area produced no information regarding this call.

Some fishermen in Bella Bella reported having heard a MAYDAY, MAYDAY, MAYDAY call January 30 between the hours of 2000 and 2100. Inquiries made in Bella Bella on this reported call indicated that the claim was unsubstan-

tiated.

The information provided by the logger in Smith Inlet was used by RCC in their search for the missing vessel. However, it is very unlikely that such a call was made, as none of the Coastal radio stations had monitored it and the call would have been recorded at those stations that have taping facilities; no such call was recorded. It should be noted that, on the announcement of a vessel being lost, it is not unusual for the Authorities to be advised that an unidentified 'MAYDAY' was heard over the period in question yet the Coastal Radio Stations, best equipped to receive such a message, have no record. This leads to the conclusion that the receipt of the original message was a misbelief, freak reception from other parts of the world, or a deliberate attempt to mislead.

15. Other fishing vessels in the area

The dragger "MARWOOD" was westbound off Nahwitti Bar at 1900, January 30, and followed a course from Cape Scott to the West Coast of the Charlottes thence north to Rennell Sound where some fishing was carried out after the worst of the weather had abated. No sign of the "SCOTIA CAPE" was seen or heard during the trip. It is assumed that if the "SCOTIA CAPE" had been fishing in or close to these areas at the time, there would have been some form of contact between the vessels, either visual, by radar or through radio communication. The "SCOTIA CAPE" would commonly head out to sea depending on location, despite stormy conditions or forecasts as the weather patterns might differ at sea, and an on-scene appraisal of the situation being normally made.

There were also numerous other trawlers operating off the West Coast of Vancouver Island, the Queen Charlotte Islands and Hecate Strait over the period in question, as circumstances allowed. Among others were the large fishing vessels "TENACIOUS", "OCEAN INVADER", "OCEAN SELECTOR" "CAPE JAMES" and various tugs and ships. None reported having seen or heard the "SCOTIA CAPE". Most of these vessels laid at anchor in sheltered waters during the worst of the storm, making the occasional short fishing trip when the weather abated suitably, while a few others stayed on the fishing grounds, riding out the worst of the weather.

16. Search for the "SCOTIA CAPE"

At 1620, February 6, 1987, the RCC, Victoria received a

to report that the fishing vessel had not been heard from since January 28 and that the vessel had been due to call B.C. Packers February 5. Approximately fifteen minutes earlier RCC had received a call from B.C. Packers to inquire of the best way to obtain full communication coverage and thus contact a vessel in northern B.C. waters. At that time (1620) the "SCOTIA CAPE" was entered on the traffic list at Bull Harbour and Prince Rupert Coast Guard radio stations. At 1625, RCC phoned the master's brother to gather more information and subsequently phoned an employee at B.C. Packers before contacting Tofino Coast Guard Radio. Communication checks were carried out to include General Marine Broadcasts (GMB) and harbour checks (UNCERTAINTY phase).

The next morning, February 7, two aircraft, a Buffalo and an Aurora, were tasked from Comox Air Force Base to search the appropriate areas where the vessel might be expected to fish in Queen Charlotte Sound. Two Coast Guard cutters, the "POINT RACE" and the Bull Harbour lifeboat were also tasked to search in the same area. Bad weather precluded the launching of aircraft until 1300. Communications and harbour checks were continued. This first search day is referred to as 'Day 1' and the area search covered the west coast of Vancouver Island, Queen Charlotte Sound, Hecate Strait and the northern end of the Queen Charlotte Islands. On 'Day 1' the "UNCERTAINTY' phase of the search was upgraded to the "ALERT" phase. The search was based on the assumption of location information supplied by the master's brother and B.C. Packers.

On 'Day 2' the West Coast of Vancouver Island was searched again and, with negative results, RCC went into the "DISTRESS" phase. The shoreline was searched from Cape Caution to Dundas Island by helicopters and Coast Guard vessels. The eastern coastal areas of Queen Charlotte Sound were searched as was the coast of the Queen Charlotte Islands. Gale force winds were blowing for most of the day but the search visibility remained good. By the end of the second day of search, a total of eight sighting reports had been received by the RCC ranging from Patos Island, Washington to Metlakatla, Alaska. Follow-up queries revealed only 2 sighting reports, one by the "CARMANAH No. 1" and the other by the "ARCTIC HAVESTER" at the north end of Vancouver Island, could not be ruled out.

The search on 'Day 3' (February 9, 1987) was based on the assumption that the "SCOTIA CAPE" might have sunk in one of three assumed last known positions (LKP):

one of three assumed last known positions (LKP):

1) 51°20'N, 129°00'W	2) 53°00'N, 132°33'W	3) 53°33'N, 133°08'W

These positions were then used to calculate the datum points for a liferaft with drogue, based on Computer Assisted Search Planning from RCC Seattle and manual drift plots calculated at RCC Victoria, based on data from the Institute of Ocean Sciences. These datum points were (from the January 28 LKP):

1) 54°53'N, 131°45'W	2) 56°57'N, 137°05'W	3) 57°22'N 137°35'W

During the following eight days, the search was expanded to include an oceanic search to the west of Sitka, Alaska. The resources utilized included Canadian fixed wing aircraft from Comox, Edmonton, Prince Rupert and Sandspit; American fixed wing aircraft from Kodiak, Alaska; helicopters from Kodiak and Sitka, Alaska and from Sandspit in B.C.; four Canadian Coast Guard vessels and one vessel from the Department of Fisheries and Oceans. A total number of 20 aircraft and 6 vessels was utilized for a total time of 699 hours (see Annex 4) and an area covering 105,800 square nautical miles was searched.

Some key areas such as the Queen Charlotte Sound, Hecate Strait and their shores were searched three times or more. A complete report on the search has been prepared by RCC Victoria.

The weather overall throughout the search was reported as having been good VFR (visual flight rules) and all reports, including those from the inevitable psychics, were evaluated and considered by RCC.

Throughout the eleven days of search, a large amount of debris was found scattered over a very large area but none positively identified as having come from the "SCOTIA CAPE". Also, throughout this period there was a very close liaison between RCC, B.C. Packers and the crew members' families.

The task of On-Scene Commander was evenly distributed between the Canadian and American resources on the scene.

On February 17, the search was downgraded to reduced status and turned over to the RCMP as a missing persons

case. On 'reduced status' the search is discontinued but mariners and SAR have been reminded to keep a look-out for the missing vessel or her equipment.

To date, no identifiable trace of the "SCOTIA CAPE" has been found.

17. **Waves**

From the special publication of Fisheries and Aquatic Sciences 'Oceanography of the British Columbia Coast' is extracted the following on the subject of waves (See Annex 5)

> Queen Charlotte Sound and the southern end of Hecate Strait are especially vulnerable to deep sea waves from the south-west which, when aided by favouring winds, undergo little attenuation as they propagate northward. In addition, frontal systems are known to rapidly generate steep mountainous seas over the broad shoal area adjacent to the east coast of the Queen Charlotte islands and leave the helpless mariner no choice but to ride them out.
>
> The most dangerous aspect of these storms is not the magnitude of the waves generated but the rapidity with which operating conditions change from difficult to dangerous or impossible. At 1500 on October 22, 1968 the seas were reported 3 m (10 ft) in height. Within 8 hrs the waves were 18.3 (60 ft) in height and were extremely dangerous for all ship operations.

A resumé of the weather conditions for January 30-31 was made by Environment Canada and is quoted:

> A developing storm (max. depth 952 mbs) approached the B.C. coast to within about 300 miles, then turned sharply northward into the Gulf of Alaska. As the associated frontal system moved across the marine area, gales and storm force winds occurred. Gales reached Cape St. James at 1100 on the 30th and Solander at 1700 on the 30th; and storm force winds (60 knots gusting to 80) were reported at Solander at 2000 of the 30th. 5 hours later Solander's wind sensor failed. Gale warnings were issued for this system at

2300 on the 29th for gales of 45 knots. Storm warnings were issued at 0500 on the 30th for winds up to 60 knots.

A wave rider buoy in location Lat. 51°30'N, Long. 130°00'W, some 45 miles south-east of Cape St. James, recorded the following wave heights for January 30-31, the period of maximum wind speeds.

Date/Time	Winds	Wave Heights
30/1000	SE 30	5 to 5.5 m
30/1300	SE 45	5 to 6 m
30/1600	SE 45	5.5 to 6 m
30/1900	SE 55	7 to 7.5 m
30/2200	SW 35	8 m
31/0100	SW 30	8 m
31/0400	SW 20	5.5 m

These readings are averaged over a period of time and do not show maximums or minimums.

The frontal passage associated with the cold front occurred after the 2000 local weather readings October 30 and the forecaster at Environment Canada in Vancouver estimated the maximum height of waves in Queen Charlotte Sound at that time to be 16 metres.

From the publication 'Oceanography of the British Columbia Coast', the following is extracted on the subject of freak waves. (See Annex 4)

> Freak or giant waves occur every so often when the various randomly moving groups of waves add up, or 'get into step' to produce a mountain of water. Their life is short, only a minute or two, as the waves soon get out of step again. As a consequence, they are totally unpredictable and can come out of nowhere. In fact, statistical theory indicates that only 1 wave in 23 is twice the height of the average, 1 in 1175 is over 3 times the average and only 1 in 300,000 exceeds 4 times the average height. Nevertheless, freak waves 20-30 m high have been reliably recorded.

The last two days of January 1987 had very severe weather conditions and, although other fishing vessels were at sea, it could be judged imprudent to leave

sheltered waters in the face of such an adverse (and subsequently proven correct) weather forecast.

18. Stability

As a fishing vessel of more than 150 gross tons and exceeding 24.4 m (80 ft) registered length, the "SCOTIA CAPE" was required to comply with the stability requirements included in the Large Fishing Vessel Inspection Regulations, with approval based upon the vessel exceeding the minimum criteria detailed in Canadian Coast Guard 'Stability, Sub-division and Load Line Standards' STAB 4. (See Annex 8)

The "SCOTIA CAPE" was one of a series of four simultaneously built sister ships, and on May 27, 1967, shortly before their completion, an inclining experiment was carried out on one, the "SCOTIA BAY". The resulting stability and loading conditions data were subsequently approved by the Canadian Department of Transport, Board of Steamship Inspection, December 12, 1967, and considered applicable to each of the individually named vessels.

Approval of the Trim and Stability Booklet was subject to the incorporation of specific notations for the guidance of the master which read, in part:

STABILITY

The following should be strictly observed, when bulk herring is being carried:

1) The aft peak oil tank and the forward oil fuel tank are not to be used for the carriage of oil fuel simultaneously when the fish holds are empty. The aft peak oil fuel tank is to be used as a transfer tank from the forward oil fuel tank for trim purposes only when the fish holds are loaded as follows:

Either A: - No. 2 hold completely filled: Condition No. 6
Or B: - Nos. 1 and 2 holds at least 50% full: Condition No. 5.

For complete details see above conditions enclosed in booklet.

3) The oil fuel consumption procedure is to be as follows:

a) Draw oil fuel from forward bunker.

b) When holds are loaded in accordance with note No. 1 then the forward oil fuel tank should be transferred aft.

c) Draw from aft oil fuel tank.

d) When aft tank is empty, draw from engine-room fuel tanks.

(The underlining used for emphasis is as shown in the actual notation).

While the above notation makes specific reference to the carriage of herring in bulk, the same oil fuel transfer and consumption sequence is also applied to all other loading conditions incorporated in the Trim and Stability Booklet, to provide guidance for the master when other catches are taken aboard. This particular oil fuel transfer sequence was adopted in order to ensure adequate transverse stability throughout all of the vessel's operating cycles which, in some configurations, would otherwise be adversely affected by cumulative free surface effects.

When only a light catch had been loaded while herring fishing, the simultaneous presence of free surfaces of bulk herring in the hold/s, and slack fresh water, oil fuel and after peak oil fuel transfer tanks, would reduce the transverse stability to such an extent that the vessel would not meet the minimum requirements of STAB 4.

When fishing for species other than herring, the catch is penned and iced, and the hold/s free surface effect is eliminated, however, the cumulative effect of slack fresh water, oil fuel, and after peak oil fuel transfer tanks could, in conjunction with only partially filled holds, still reduce the transverse stability below minimum regulatory requirements.

The predominant proportion of the total free surface is due to the carriage of oil fuel in the after peak oil fuel transfer tank, and consequently the intent of the

notation in the approved Trim and Stability Booklet was to eliminate or delay its onset, until it could be safely absorbed by the vessel's improved stability resulting from the increasing catch stowed low down in the holds.

The wording of the notation in the approved Trim and Stability Booklet is open to ambiguous interpretation, one of which being that the restrictions were only applicable when the vessel was carrying herring in bulk, however, the regulatory minimum stability requirements of STAB 4, are applicable for all modes of fishing notwithstanding the employment of the vessel, and therefore the notation was appropriate for all fishing operations.

It is the responsibility of the master to ensure that his vessel maintains adequate stability at all times, and in this instance, in view of his knowledge of the casualty previously sustained by the vessel's sistership, it would have been prudent to have either carried out the oil fuel loading and transfer sequence in accordance with the notation and departure loading conditions in the approved Trim and Stability Booklet, or, if the intent of the notation was not absolutely clear, to have sought clarification from the Ship Safety Branch of CCG or the builders.

The arrangement and construction of the "SCOTIA CAPE" was such that the forward and after oil fuel tanks, and the freshwater tank, extended the full breadth of the vessel. The forward oil fuel tank and the freshwater tank were fitted with centreline non-oil/watertight wash bulkheads which, while lessening the surging effect of their contents, did not reduce the free-surface effects and heeling moments induced by the vessel's motion. A wash bulkhead was not fitted in the after peak oil fuel transfer tank, but the athwartship movement of liquid was interrupted to some extent by the obstruction caused by the fishing ramp built into the stern of the vessel. However, due to the slope of the stern ramp, the configuration of the tank was such that as the level of oil fuel reduced, the free-surface effect increased and effectively extended the full breadth of the vessel.

The duration of previous voyages and the last planned voyage was such that the combined capacities of the forward and engine-room oil fuel tanks were insufficient, and reportedly the vessel routinely left port with the after peak oil fuel transfer tank approximately 85/90% full, and that this additional fuel was consumed

first. This oil fuel loading and consumption sequence was contrary to the guidance provided by the notation included in the vessel's approved Trim and Stability Booklet.

A post-casualty stability analysis focused upon the detrimental effects on the vessel's transverse stability characteristics brought about by the reported oil fuel loading and consumption sequence, together with additional stress induced by the recorded storm force winds and sea conditions prevailing some 30 hours after the vessel's departure. (See Annex 6)

The weights of consumables reportedly onboard the vessel upon departure for her last voyage were:-

Oil fuel in aft peak transfer tank	= 26.99 tonnes
Oil fuel in engine-room tank (S)	= 10.10 tonnes
Oil fuel in engine-room tank (P)	= 5.23 tonnes
Oil fuel in forward tank	= 28.64 tonnes
Lub oil in engine-room tank	= 2.21 tonnes
Hydraulic oil in engine-room tank (S)	= 2.85 tonnes
Fresh water in aft tank	= 18.59 tonnes
Provisions and stores	= 1.01 tonnes
Crew and effects	= 1.01 tonnes
Preservation ice in Holds Nos. 1 & 2	= 66.06 tonnes

It should be noted that the recommended departure condition for the particular type of fishing engaged in at the time is illustrated in the Approved Trim and Stability Booklet by condition titled 'Wet Fish Departure with Ice'. In this condition the vessel is shown with her aft peak oil fuel (transfer tank) empty.

The previous reported deadweight and loading details show that upon departure, the vessel's transverse stability characteristics were significantly below the minimum regulatory requirements, due primarily to the free-surface effect of the additional oil fuel in the after peak oil fuel transfer tank. As oil fuel was consumed on the way to and, possibly, after arrival at the fishing grounds, the increased free-surface effect created in the after peak oil fuel transfer tank caused a further reduction of the vessel's transverse stability.

Due to probable encounter with the forecast storm force winds and high seas shortly after arrival at the fishing grounds, it is unlikely that fishing was immediately possible and consequently no significant early improvement in stability would have been achieved/derived from

the loading of fish catch low down in the vessel's holds, as was reportedly routinely accomplished on previous voyages in less severe weather conditions. It is likely that the heeling and other detrimental effects caused by the reported storm force winds of 50 knots, gusting to 70 knots, and high seas of 6 to 8 metres, were such that the vessel's already limited ability to withstand the weather was suddenly overcome and that she capsized, effectively precluding any abandonment or radioed distress call.

In general, few fishermen fully understand free-surface effect and fewer appreciate the substantial loss of transverse stability when water, even a few inches, is shipped and retained on deck. Coupled with the loss of effective water-plane area when the deck edge is submerged, the effects can be disastrous. Furthermore, in high winds and confused sea conditions a vessel's motion can cause the transom and stern to occasionally emerge, resulting in a sudden and dramatic loss of waterplane area and hence, stability. If the "SCOTIA CAPE" encountered such a situation in the prevailing storm conditions, then the impetus caused by a sudden reduction or fluctuation could have overcome her already lowered dynamic stability characteristics, and initiated heeling from which she did not recover.

19. **Sister Ships Operating History**

The four sister ships built simultaneously in 1967 were named the "SCOTIA BAY", "SCOTIA CAPE", "SCOTIA POINT" and "SCOTIA PORT".

The "SCOTIA BAY" capsized and sank in Dixon Entrance, B.C. in 1979; at that time she had been owned for some 4 years by a partnership of Captains V. Mark and R. Foote, both these persons are now lost on the "SCOTIA CAPE"; they were also associated with the ownership of the "SCOTIA CAPE". The SCOTIA BAY" was sailed from the East Coast to the West Coast of Canada where she had continually fished as a trawler until her loss. Similarly, in 1979, the "SCOTIA CAPE" was brought from the East coast to the West coast.

Following her completion in 1968, the "SCOTIA POINT" fished successfully on the East Coast of Canada as a combination seiner/trawler and in 1977, was employed solely as a herring seiner utilising a chilled sea water catch preservation system in her No. 2 hold. Prior to entering this service the No. 2 hold sides and bottom were relined with cement, subdivided into port and

starboard compartments by a watertight bulkhead fitted on the centreline, and drainage sumps and chilled water piping systems and equipment were installed. An inclining experiment was carried out May 21, 1977, and the resulting trim and stability booklet indicated that the new lightship weight and vertical centre of gravity of the vessel were 437 tons and 12.42 ft respectively. Her name was changed to "SENATOR DON" in 1983 and in 1986 was changed again to "TENACITY I" at which time her new owners converted the vessel for scallop dragging operations on the East Coast of Canada where she now operates. During the conversion, extensive modifications were carried out, including the removal of all seining and trawling gear, together with the trawling gallows, booms and virtually all of the upper deck plating aft of amidships. The stern ramp was eliminated and the upper half of the original after peak oil fuel transfer tank incorporated into a new gear store. The remaining volume is no longer used for the carriage or transfer of fuel oil. Upon completion of the conversion to scallop dragging, an inclining experiment was carried out and the resulting Trim and Stability Booklet was approved by Ship Safety Branch, CCG, December 2, 1986 showing her current lightship weight and vertical centre of gravity as 382.5 tons and 10.92 ft respectively. These current figures may be compared with those when the vessel was originally built, which were 374 tons and 12.59 ft.

The "SCOTIA PORT" was sold in 1975 to an American company, renamed "SUB SIG II" and now operates as a scientific research vessel on the East Coast of the United States. As she was no longer to be used for fishing, extensive modifications were made during her conversion, and she is reported to have operated successfully in all weathers since then. The modifications carried out since her change of ownership included the removal of all seining/trawling equipment, combination winch, net reels and trawl davits, together with the addition of concrete ballast in the redundant fish holds. An inclining experiment was carried out on the owners behalf January 28, 1976, and subsequently, upon recommendations from their consulting naval architects, the owners arranged to subdivide the original after peak oil fuel transfer tank into three separate oil tanks by installing two longitudinal oil-tight bulkheads and additional oil fuel piping.

20. Qualifications of crew members

It would appear that the "SCOTIA CAPE" was manned by a

crew of seven who were better qualified than those of many similar vessels.

The master had over 25 years experience fishing on the British Columbia Coast, most of those years as master of his own vessel. He held a Fishing Master Certificate issued in Prince Rupert, July 25, 1977. He had an excellent reputation as a fisherman and a master and, although stated to be a cautious person who had considerable respect for the sea, was acknowledged to often fish the vessel in adverse weather.

The mate held a Fishing Master Certificate issued in Prince Rupert, August 23, 1977. He had over 30 years experience on trawlers, half of them on the Coast of Nova Scotia and the rest on the British Columbia coast. He was especially known for his skills at locating fish and was respected for his vast experience and knowledge of the local waters.

The engineer did not hold a Certificate of Competency nor was he required to by regulation. He had 9 years experience on fishing vessels and had sailed on the "SCOTIA CAPE" since 1984.

One crew member held a Fishing Master Class III Certificate issued in Vancouver, March 4, 1985 and the three other crew members had extensive fishing experience on the British Columbia coast.

21. **Possible causes of the ship's disappearance**

The "SCOTIA CAPE" was well equipped with radio telephones having four VHF units one SSB and one Citizen's Band. During her last voyage, she was heard communicating with the "CARMANAH", January 28 and all her radiotelephones were reported to have been in good condition prior to departure. If she had broadcast a distress message, it is unlikely that such a transmission would not have been heard. This leads irresistibly to the conclusion that whatever happened to the "SCOTIA CAPE", happened very suddenly.

Consideration has been given to the following possibilities:

Collision/Grounding

No wreckage or oil has been found or seen. This suggests that the "SCOTIA CAPE" was lost with her hull intact and did not sink as a result of a collision or

because her watertight integrity was breached in any other way.

Engine-room flooding

Flooding of the engine-room compartment is possible and cannot be completely ruled out or disregarded as a possible cause of the vessel's disappearance. However, taking into consideration the trouble free operation of the vessel prior to the casualty, the good maintenance of the vessel and the existence of an engine-room bilge high level alarm makes this eventuality doubtful.

Superstructure icing

The temperature was mild throughout the period of the last voyage and from reports of other vessels in the areas in question, the temperature did not drop below freezing and icing on the superstructure is not thought to have been a factor in this casualty.

Fire

If there had been a fire on board the vessel, it is reasonable to assume that time would have allowed radio messages to be sent and/or the liferaft to be launched; and the likelihood of debris from the ship would have been increased.

Capsize

The lack of debris from the vessel and no radio distress messages indicate that capsizing seems most likely to have happened and that it was unforeseen and sudden. The worst weather conditions were on January 30 and if the vessel was in the Queen Charlotte Sound area, there exists a strong possibility that:

1) very high waves coupled with strong winds heeled the vessel to an angle from which she was unable to recover, or

2) the fishing net may have become fouled on a bottom obstruction bringing the vessel to a sudden stop, loosing all steerageway and becoming vulnerable to the prevailing extreme weather, or

3) one of the warps could have broken while trawling causing the vessel to sheer to one side, exposing her beam to the sea and wind, or

4) if fishing operations were commenced in the storm conditions, the catch may have slewed to one side while being hauled onto the upper deck, causing a large heel and loss of transverse stability, in a similar but more rapid manner as that which reportedly occurred when her sister ship, "SCOTIA BAY", was lost in 1979.

Any one of the four possibilities, or a combination thereof, in the known weather conditions, could have caused the vessel to capsize.

Based on the knowledge of similar previous casualties, where there have been no distress messages or signals received, and no debris or significant oil fuel found, the most likely cause of the loss of the "SCOTIA CAPE" is considered to be one of sudden capsize.

In investigation of previous sudden capsizings of fishing vessels, these casualties have often been found to have occurred at the time of maximum wind speeds.

Findings

The loss of the "SCOTIA CAPE" and her seven man crew occurred in an unknown position, in Northern British Columbia waters sometime after late evening January 28, 1987; the reason for the loss is not known. However it would appear that sudden capsize is a likely explanation and, accepting this theory, then the following could be considered contributing factors:

- the vessel sailed in the face of adverse weather forecasts, for fishing grounds located in an area where storm force conditions were predicted and later experienced and recorded;

- the crew was overconfident in the vessel's ability to sail and fish in adverse weather;

- upon departure from Steveston B.C., the vessel carried a part load of fuel oil in the aft peak fuel oil transfer tank and consequently her transverse stability characteristics did not comply with the minimum regulatory requirements of STAB 4;

- as fuel oil was consumed on the way to and after arrival at the fishing grounds, the increasing free surface effect created in the aft peak fuel oil transfer tank further reduced the vessel's transverse stability characteristics;

- the vessel sailed with fuel oil in the aft peak oil fuel transfer tank, contrary to the condition titled 'Wet Fish Departure with Ice", in her approved Trim and Stability Booklet; and

- the "SCOTIA CAPE" was known to be a 'wet ship', meaning that when operating in adverse weather, the working decks readily took seas. Taking such seas would further reduce the vessel's stability.

Other Findings

The wording in the Approved Trim and Stability Booklet, referring to the use of the aft peak oil fuel transfer tank, such that a particular sequence of operation "should be strictly observed, when bulk herring is being carried" does not address the fact that similar use of the tank in other fishing modes was equally critical.

No record can be found that recommendations made following the capsize of the "SCOTIA BAY" were acted upon by the appropriate Authorities.

The suddenness of the casualty effectively precluded any orderly abandonment by personnel or distress radio call.

The "SCOTIA CAPE" carried no EPIRB, the transmission from which may have alerted SAR authorities to the distress, nor was there a daily reporting regime in place which, again, may have alerted the owners and thence SAR to the distress.

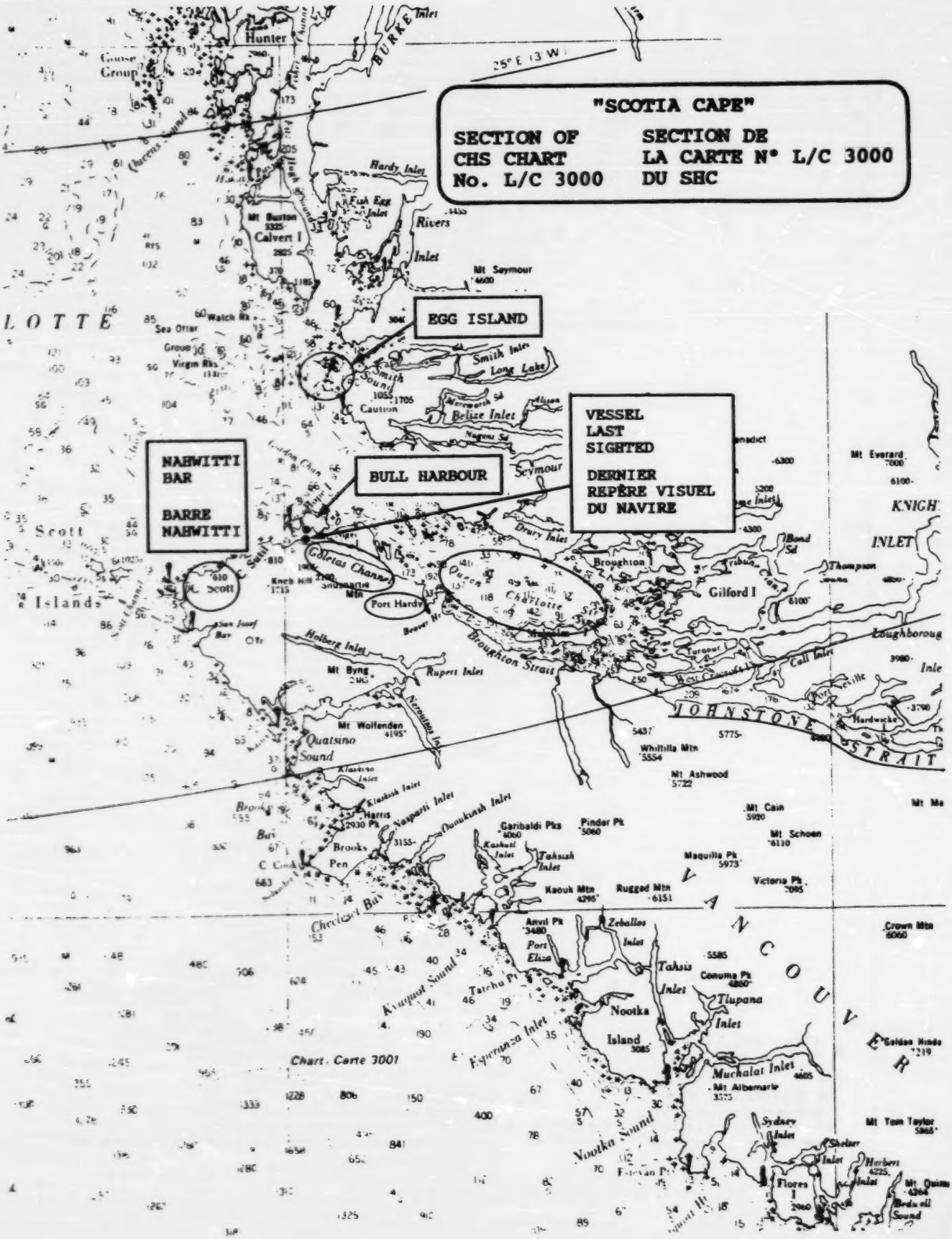
The "SCOTIA CAPE" liferaft was not hydrostatically secured to the vessel and an automatic release may have assisted any survivors in the water and, subsequently, in the location of the wreck.

OTTAWA, ONTARIO
OCTOBER 1987.

Glossary

BP	Between perpendiculars.
Bulkhead	A name given to any vertical partition which separates different compartments or spaces from one another.
Bulwarks	The upper section of the frames and side plating, which extends above and around the upper deck.
CCG	Canadian Coast Guard.
Cod end	The extreme end of the trawl net which acts as general receptacle for the various fish which enter the net.
Cofferdam	The empty space between two bulkheads separating two adjacent compartments.
CSA	Canada Shipping Act.
DOT	Department of Transport.
EPIRB	Emergency position-indicating radio beacon. A transmitting device whose signal may be received by SAR vehicles or orbitting satellite, indicating the position of a craft in need of assistance.
Frame	One of the transverse girders of a ship's hull extending from the keel to the highest continuous deck.
Freeing port	A rectangular or oval opening in the bulwarks, close to the deck and fitted with a hinged flap which opens outward to allow water shipped on deck to run freely overboard but does not allow water to be shipped.
Free surface effect	The loss of effective stability due to a surface of liquid which is free to move.
kW	Kilowatt or 1000 watts.
Megger test	A test of insulation resistance of electrical circuits.

RCC	Rescue Co-ordination Centre.
Reference port	A port for which tidal predictions are published in the form of daily tables.
Samson post	A short heavily built tubular mast placed about midway between the centerline and the bulwarks from which a derrick is supported and stayed.
SAR	Search and Rescue.
Senhouse slip	A steel ellipse with dimensions generally of a ratio 3:1, with a hinged hook at one end and a smaller ellipse on the larger which is slipped over the tine of the hook to afford a quick release.
"Shipped"	In this context, means large amounts of water taken on the ship's deck in storm conditions.
SOLAS	Safety of Life at Sea.
Sighting report	Terminology used in SAR operations to indicate reports made to RCC from any source regarding possible visual observation of the search object.


"SCOTIA CAPE"
SECTION OF CHS CHART No. L/C 3000
SECTION DE LA CARTE N° L/C 3000 DU SHC
EGG ISLAND
NAHWITTI BAR
BARRE NAHWITTI
BULL HARBOUR
VESSEL LAST SIGHTED
DERNIER REPÈRE VISUEL DU NAVIRE
Hunter
Goose Group
Calvert I
Rivers Inlet
Smith Sound
Smith Inlet
Long Lake
Belize Inlet
Seymour
Drury Inlet
Broughton
Gilford I
Port Hardy
Goletas Channel
Broughton Strait
Holberg Inlet
Rupert Inlet
Quatsino Sound
Mt Wolfenden
Mt Byng
Brooks Pen
Checleset Bay
Kyuquot Sound
Esperanza Inlet
Nootka Island
Nootka Sound
Tahsis Inlet
Tlupana Inlet
Muchalat Inlet
Mt Albemarle
Sydney Inlet
Flores I
Mt Cain
Mt Schoen
Maquilla Pk
Victoria Pk
Rugged Mtn
Kaouk Mtn
Garibaldi Pks
Pinder Pk
Whitilla Mtn
Mt Ashwood
Mt Everard
Thompson
Loughborough
Hardwicke
Mt Tom Taylor
Chart - Carte 3001
LOTTE
Scott Islands
KNIGHT INLET
JOHNSTONE STRAIT
VANCOUVER
25° E (3 W)

"SCOTIA CAPE"

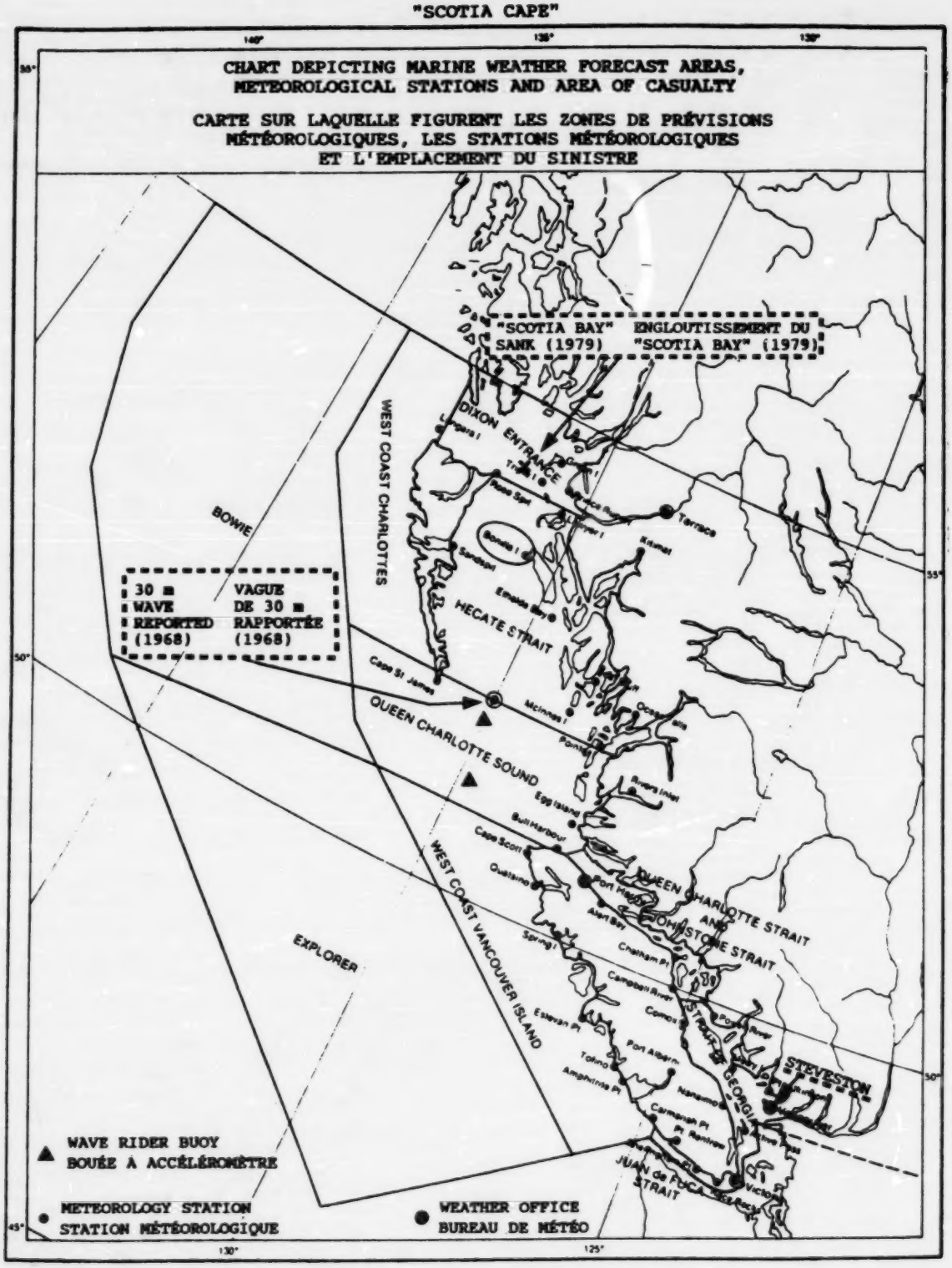


CHART DEPICTING MARINE WEATHER FORECAST AREAS, METEOROLOGICAL STATIONS AND AREA OF CASUALTY
CARTE SUR LAQUELLE FIGURENT LES ZONES DE PRÉVISIONS MÉTÉOROLOGIQUES, LES STATIONS MÉTÉOROLOGIQUES ET L'EMPLACEMENT DU SINISTRE
"SCOTIA BAY" SANK (1979)
ENGLOUTISSEMENT DU "SCOTIA BAY" (1979)
30 m WAVE REPORTED (1968)
VAGUE DE 30 m RAPPORTÉE (1968)
DIXON ENTRANCE
WEST COAST CHARLOTTES
BOWIE
HECATE STRAIT
QUEEN CHARLOTTE SOUND
WEST COAST VANCOUVER ISLAND
EXPLORER
QUEEN CHARLOTTE STRAIT AND JOHNSTONE STRAIT
STRAIT OF GEORGIA
STEVESTON
JUAN de FUCA STRAIT
Terrace
Kitimat
Cape St James
Cape Scott
Port Hardy
Alert Bay
Campbell River
Comox
Port Alberni
Tofino
Nanaimo
Victoria
WAVE RIDER BUOY
BOUÉE À ACCÉLÉROMÈTRE
METEOROLOGY STATION
STATION MÉTÉOROLOGIQUE
WEATHER OFFICE
BUREAU DE MÉTÉO

ANNEX 1

Reports from local weather stations.

January 28, 1987

Station	Time	Wind (Dir. & Force)	Sea
Egg Island	1400	SW 14	Low W
	1700	SE 12	Low W
	1900	SE 18	Low W
	2300	SE 32, G* 38	Mod W
Cape St. James	1400	W 9	Low W
	1700	S 16	Low E
	1900	SE 12	Unknown
	2300	SE 32,G 40	Unknown
McInnes Island	1400	SE 2	Low SW
	1700	SE 11	Low SW
	1900	SE 15	Low SW
	2300	E 14 Est.	Low SW
Cape Scott	1300	SW 12	Mod SW
	1700	S 13, G 22	Mod SW
	1900	SE 11	Mod SW
	2300	SE 20, G 44	Rough
Bonilla Island	1400	S 9 Est.	Mod S
	1600	S 8 Est.	Mod S
	1900	SE 10 Est.	Low S
	2200	E 10, G Est.	Mod S

January 29, 1987

Egg Island	0500	SE 48, G 60	Rough 3 m Mod W
	0800	SE 22	Mod W
	1100	SE 24	Mod W
	1400	SE 36, G	Mod S
	1700	SE 30, G 36	Mod W
	2000	SE 40, G 52	Mod W
	2300	SE 48, G 58	Rough 2.4 m Mod W
Cape St. James	0500	SW 27	Unknown
	0800	S 27	Unknown
	1100	S 21	Mod SE
	1400	S 16	Mod SW
	1700	E 6	Low SE
	2000	NE 13 Est., G 24	Unknown
	2300	N 6	Unknown

* G = Gusting Est. = Estimated

McInnes Island	0500	SW 27	Mod SW
	0800	SE 20	Mod SW
	1100	SE 22	Mod SW
	1400	E 10 Est.	Mod SW
	1700	E 8 Est.	Low-Mod SW
	2000	N 8 Est.	Low SW
	2300	NE 6 Est.	Low SW
Cape Scott	0400	SW 10	Rough 2.1 m Hvy SW
	0800	E 5	Mod SW
	1100	SE 9	Low-Mod SW
	1400	NE 10	Mod SW
	1700	SE 30,G 46	Rough 4 m Mod-Hvy SW
	2000	SE 20, G 40	Rough 4 m Mod-Hvy SW
	2300	SE 35, G 62	Rough 4.8 m Mod-Hvy SW
Bonilla Island	0400	SE 32, G Est.	Mod-Hvy S
	0700	SE 26, G 33 Est.	Mod-Hvy S
	1000	S 25, G 3 2 Est.	Mod SW
	1300	S 25, G 30 Est.	Mod S
	1600	SE 10, G Est.	Mod S
	1900	SE 8 Est.	Mod S
	2200	SE 4 Est.	Mod S

<u>January 30, 1987</u>

Egg Island	0500	W 15, G 20	Mod W
	0800	SW 18	Mod W
	1400	SE 22	Mod W
	2000	SE 35, G 52	Mod W
	2300	SE 54, G 66	Rough 3 m Mod W
Cape St. James	0500	W 19	Unknown
	0800	S 21	Unknown
	1400	SE 45, G 52	Rough 3 m Mod SE
	2000	SE 57, G 74	Unknown
	2300	SW 34	Unknown
McInnes Island	0500	W 20	Mod SW
	0800	SE 10	Mod SW
	1400	SE 29, G 36	Mod SW
	2000	SE 30, G 45	Mod SW
	2300	SE 44, G 55	Mod 2.4 m Mod SW

Cape Scott	0500	W 7	Mod-Hvy SW
	0800	SW 10	Mod-Hvy SW
	1400	SE 20, G 37	Rough, Mod SW
	2000	SE 26, G 50	Rough 3.7 m Mod-Hvy SW
	2200	SE 25, G 38	Rough 3.7 m Mod-Hvy SW
Bonilla Island	0400	NW 16 Est.	Low SW
	0700	SE 18, G Est.	Mod S
	1000	S24, G 28 Est.	Mod S
	1400	SE 34, G Est.	Mod 1.2 m Mod S
	1900	SE 42, G 54 Est.	Rough 3.6 m Mod-Hvy S
	2200	SE 34, G 55 Est.	Rough 3.6 m Hvy S

<u>January 31, 1987</u>

Egg Island	0500	SE 12	Mod W
	0800	SE 10	Mod W
	1100	E 8	Mod W
	1300	SE 16	Mod W
	1700	E 12	Mod W
	1900	E 10	Low-Mod W
	2300	NE 8	Low-Mod W
Cape St. James	0500	W 22	Unknown
	0800	S20	Unknown
	1100	S17	Rough 2.1 m Mod-Hvy SE
	1300	S 14	Low-Mod SE
	1700	SE 32	Low-Mod SE
	1900	SE 23, G 33	Unknown
	2300	SE 28	Unknown
McInnes Island	0500	SE 13	Mod-Hvy SW
	0800	S 11	Mod SW
	1100	SE 3	Mod SW
	1300	SE 14	Mod SW
	1700	SE 14	Mod SW
	1900	NE 8 Est.	Mod SW
	2300	N 4 Est.	Low-Mod SW

Cape Scott	0400	S 4	Mod SW
	0800	S 5	Mod SW
	1100	SE 7	Mod SW
	1300	SE 6	Mod SW
	1700	E 4	Mod SW
	1900	E 5	Mod SW
Bonilla Island	0700	S 25 Est.	Mod-Hvy S
	1000	S 16, G Est.	Mod-Hvy S
	1300	S 18, G Est.	Mod-Hvy S
	1600	E 8 Est.	Mod S
	1900	E 12, G Est.	Mod S
	2200	E 14, G Est.	Mod S

<u>February 1, 1987</u>

Egg Island	0400	E 18	Low-Mod W
	0800	SE 35	Mod W
	1100	SW 34, G 44	Rough 2.4 m Hvy W
	1400	SW 36, G 46	Rough 3 m Hvy SW
	1700	SW 20	Mod-Hvy SW
	1900	SE 18	Mod SW
	2300	SE 15	Mod SW
Cape St. James	0400	E 43	Unknown
	1100	NW 24	Mod SE
	1400	W 30, G 38	Low SE
	1700	W 25	Low-Mod SE
	1900	SE 25	Unknown
	2300	SE 35	Unknown
McInnes Island	0400	NE 10 Est.	Low SW
	1100	E 30 Est.	Mod SW
	1400	SW 34, G 42	Mod 1.8 m Mod SW
	1700	SW 5	Mod SW
	1900	SE 12	Mod SW
	2300	SE 20	Mod SW
Cape Scott	0400	SE 15	Mod SW 1.8 m chop
	0800	SW 20, G 36	Rough 2.7 m Mod-Hvy SW
	1100	SW 22, G 36	Rough 2.7 m Mod-Hvy SW
	1400	SW 22, G 38	Rough 3 m Mod-Hvy SW

	1700	SW 10, G 19	Rough 2.4 m Mod-Hvy SW
	1900	S 10	Rough 2.4 m Mod-Hvy SW
	2300	SE 10	Rough 2.4 m Mod-Hvy SW
Bonilla Island	0400	NE 18, G Est.	Mod S
	0700	E 14 Est.	Mod S
	1000	E 6 Est.	Mod S
	1300	NW 2 Est.	Mod S
	1600	SE 4 Est.	Mod S
	1900	SE 18, G Est.	Mod S
	2200	SE 14, G 19 Est.	Mod S

February 2, 1987

Egg Island	0500	SE 10	Low-Mod W
	0700	SE 14	Low W
	2000	SE 14	Low-Mod W
	2200	SE 18	Low W
Cape St. James	0500	SE 35, G 42	Unknown
	0700	SE 35, G 47	Unknown
	2000	S 12	Unknown
	2200	SE 11	Unknown
McInnes Island	0500	E 12 Est.	Low SW
	0700	E 12 Est.	Low SW
	2000	SE 24, G 29	Mod SW
	2200	SE 20	Mod SW
Cape Scott	0500	E 5	Mod SW
	2000	SE 13, G 20	Mod SW
Bonilla Island	0400	SE 31, G 36 Est.	Mod S
	0700	SE 26, G 33 Est.	Mod 1.2 m Mod-Hvy S
	1000	SE 20, G 35 Est.	Rough 2.4 m Mod-Hvy S
	1300	SE 30, G 35 Est.	Rough 2.4 m Mod-Hvy S
	1600	SE 24, G 32 Est.	Rough 2.1 m Mod S
	1900	SE 18 Est.	Mod S
	2200	SE 14 Est.	Mod S

February 3, 1987

Egg Island	0700	SE 24, G 42	Mod-Low W
	0800	SE 34, G 42	Mod-Low W
	1100	SE 38, G 48	Mod-Low SW
	1400	SE 32, G 40	Mod-Low SW
	1700	SE 25, G 34	Mod-Low SW
	2000	SE 39, G 38	Mod-Low SW
	2300	SE 30, G 40	Mod-Low SW
Cape St. James	0700	SE 49, G 63	Unknown
	0800	SE 49, G 63	Unknown
	1100	SW 37, G 65	Mod SE
	1400	S 19	Mod-Hvy SE
	1700	SE 31	Mod-Hvy SE
	2000	SE 33, G 38	Unknown
	2300	SE 45, G 63	Unknown
McInnes Island	0700	E 15 Est.	Low SW
	0800	E 15 Est.	Low SW
	1100	E 15 Est.	Low SW
	1400	SE 35, G 45	Rough 2.4 m Mod SW
	1700	SE 29	Rough 2.1 m Mod SW
	2000	E 6 Est.	Mod SW
	2300	E 12 Est.	Low SW
Cape Scott	0700	SE 7	Mod SW
	0800	SE 7	Mod SW
	1100	SE 24, G 39	Rough 3.6 m Mod-Hvy SW
	1400	SE 24, G 41	Rough 3.6 m Mod-Hvy SW
	1700	SE 15, G 24	Rough 3.6 m Mod SW
	2000	SE 8	Rough 2.4 m Mod SW
	2300	SE 12, G 22	Mod SW
Bonilla Island	0400	SE 24, G 30 Est.	Mod S
	0700	E 33, G 38 Est.	Mod S
	1000	E 32, G 38 Est.	Mod 1.8 m Mod-Hvy S
	1300	SE 28, G 36 Est.	Rough 2.4 m Hvy S
	1600	S 26, G 30 Est.	Mod 1.8 m Mod-Hvy S

	1900	SE 30, G 32 Est.	Mod 1.8 m Mod-Hvy S
	2200	SE 31, G 38 Est.	Rough 2.1 m Hvy S

February 4, 1987

Egg Island	0500	SE 46, G 58	Rough 3 m Mod W
	0800	SE 40, G 50	Rough 2.4 m Mod W
	1100	SW 25, G 31	Mod 1.8 m Mod W
	1400	E 8	Low-Mod W
	1700	SE 10	Mod W
	2000	SE 8	Low-Mod W
	2300	S 10, G 18	Low-Mod W
Cape St. James	0500	SW 25	Unknown
	0800	W 18	Unknown
	1100	SW 12	Mod SE
	1400	SW 9	Low-Mod SE
	1700	SE 5	Low-Mod SW
	2000	SE 19, G 30	Unknown
	2300	E 27	Unknown
McInnes Island	0500	SE 30, G 38	Mod SW
	0800	SW 30, G 44	Rough 2.4 m Mod SW
	1100	S 5	Mod-Hvy SW
	1400	SW 6	Mod-Hvy SW
	1700	SE 10	Mod-Hvy SW
	2000	SE 10	Mod-Hvy SW
	2300	NE 8 Est.	Mod SW
Cape Scott	0500	S 36, G 49	Rough 5.5 m Hvy SW
	0800	S 16	Rough 2.4 m Hvy SW
	1100	Calm	Mod-Hvy SW
	1700	S 2	Mod SW
	2000	E 5	Mod SW
	2300	E 3	Mod SW
Bonilla Island	0400	SE 42, G 52 Est.	Rough 2.4 m Hvy S
	0700	SE 24, G Est.	Mod 1.8 m Hvy S
	1000	SW 12, G Est.	Hvy S

	1300	SW 16, G Est.	Mod-Hvy S
	1600	S 12 Est.	Low-Mod S
	1900	SE 10 Est.	Low-Mod S

February 5, 1987

Egg Island	0500	SE 38, G 48	Low-Mod W
	0800	SE 46, G 56	Low-Mod W
	1100	SE 40, G 48	Mod 1.2 m Low-Mod W
	1400	SE 30, G 36	Low-Mod W
	1700	SE 25, G 32	Low-Mod W
	2000	SE 24, G 30	Low-Mod W
	2300	SE 12	Low W
Cape St. James	0500	SE 44, G 63	Unknown
	0800	SE 6, G 44	Unknown
	1100	S 22, G 33	Mod 1.8 m Mod-Hvy S
	1400	S 26	Mod 1.8 m Mod-Hvy S
	1700	S 28	Mod 1.8 m Mod-Hvy S
	2000	S 21	Unknown
	2300	S 21	Unknown
McInnes Island	0500	N 20 Est.	Mod SW
	0800	SE 33, G 42	Rough 2.4 m Mod SW
	1100	SE 34, G 42	Rough 3 m Mod SW
	1400	SE 30, G 37	Rough 2.4 m Mod SW
	1700	SE 25, G 33	Rough 2.4 m Mod SW
	2000	SE 24, G 29	Rough 2.1 m Mod SW
	2300	SE 24	Rough 2.1 m Mod SW
Cape Scott	0500	SE 28, G 45	Rough 3.7 m Mod-Hvy SW
	0800	SE 30, G 46	Rough 4.9 m Hvy SW

	1100	SE 27, G 41	Rough 4.6 m Hvy SW
	1400	SE 20, G 33	Rough 3.7 m Mod-Hvy SW
	1700	SE 16, G 26	Rough 3 m Mod Sw
	1900	SE 14	Rough 2.4 m Mod SW
	2300	S 10	Mod 1.8 m Mod SW
Bonilla Island	0400	SE 26, G 34 Est.	Low-Mod S
	0700	SE 31, G 40 Est.	Mod S
	1000	SE 34, G Est.	Rough 2.1 Hvy S
	1900	SE 29, G 34 Est.	Mod 1.8 m Mod-Hvy S
	2200	SE 28, G 36 Est.	Mod 1.8 m Mod-Hvy S

ANNEX 2

Form S. I. C. 31

ISSUED BY THE
DEPARTMENT OF TRANSPORT
CANADA

INSPECTION CERTIFICATE

FOR

A Commercial Fishing Vessel propelled by steam or internal combustion engines and exceeding 150 tons gross tonnage.

NAME OF SHIP	OFFICIAL NUMBER	GROSS TONNAGE	PORT OF REGISTRY
SCOTIA CAPE	328502	390	PRINCE RUPERT, B.C

THIS IS TO CERTIFY:–

1. That the above mentioned ship has been duly inspected in accordance with the provisions of the Canada Shipping Act, that the provisions of the said Act relating to the inspection of steamships, and applicable to such ship, have been complied with, and that the ship is, subject to such limitations as may be specified herein, fit to ply on HOME TRADE voyages, Class II. The number of persons, including the master, comprising the crew, is 8.

LIMITATIONS:–

This certificate shall be valid only for voyages as follows:

AS ABOVE AND SUBJECT TO THE ACCEPTED CONDITIONS OF LOADING

CONTAINED IN THE OWNERS STABILITY DOCUMENT BEING ADHERED TO

2. That the inspection showed:–

(a) (i) that the main boilers may carry a working pressure not in excess of _____ KPa,

(ii) that the auxiliary boilers may carry a working pressure not in excess of _____ KPa,

(iii) that the air receivers may carry a working pressure not in excess of 1724 KPa,

(b) that the ship carried:–

ONE lifeboats, capable of accommodating 4 persons

_____ boats, dories or skiffs, capable of accommodating _____ persons

TWO inflatable liferafts, capable of accommodating 30 persons

FOUR lifebuoys, 11 lifejackets.

8 Immersion Suit

This certificate will remain in force until the 31 day of May 19 87

R.R. UPADHYAYA

Steamship Inspector, as to the hull and equipment, other than fire extinguishing equipment for the machinery space.

R.R.UPADHYAYA

Steamship Inspector, as to the machinery, and fire extinguishing equipment for the machinery space.

Date of issue _____

NOTES: (1) THIS CERTIFICATE IS TO BE POSTED IN A CONSPICUOUS PLACE ON BOARD THE SHIP.
(2) MASTERS AND OWNERS SHOULD ENSURE THAT THE VESSEL IS SO LOADED AND BALLASTED AS TO SECURE A PROPER MEASURE OF STABILITY.
(3) THE CANADA SHIPPING ACT PROVIDES PENALTIES FOR OVERLOADING.
(4) THE CANADA SHIPPING ACT REQUIRES THE MASTER OR OWNER OF A SHIP, WHICH HAS SUSTAINED DAMAGE AFFECTING HER SEAWORTHINESS OR HER EFFICIENCY, TO REPORT THE MATTER TO THE CHAIRMAN OF THE BOARD OF STEAMSHIP INSPECTION AS SOON AS POSSIBLE. THIS REPORT MAY BE FORWARDED THROUGH THE NEAREST DIVISIONAL SUPERVISOR, STEAMSHIP INSPECTION SERVICE.

88-0169(1198)
3-76

ANNEX 3

SAILING DIRECTIONS - BRITISH COLUMBIA COAST (NORTH PORTION)

9 **Tidal streams and currents** at the south end of Queen Charlotte Sound *(50°59'N., 129°17'W.)* are rotary, turning clockwise, with the maximum rate (2 kn) occurring 4 hours before HW at Prince Rupert, setting 025°. The minimum rate occurs at HW at Prince Rupert and sets 190°. At neap tides a maximum ebb (1 kn) occurs 2 hours after HW at Prince Rupert, setting 230°, but is not noticeable at spring tides.

10 About sixteen hours after the passage of a storm through the sound, and where the wind veers from SE to SW to NW, the maximum currents will occur about 3.5 hours after HW at Prince Rupert, and may remain out of phase for three or four days. The initial change of phase is usually accompanied by a surge of current about 0.5 kn greater than is usual. This change in the phase of the current is caused by a wind driven inertial current of period 15.4 hours and a starting velocity of 30 cms/sec. (0.6 kn). This current slowly decays over a three- to four-day period.

17 **Caution.** — During a period of calm weather in 1968 an oil rig, drilling in *52°N., 130°W.*, experienced unusual currents of 2 to 3 kn setting south. Such a strong outflow from Hecate Strait can occur when the tidal range is large and the barometric pressure difference between the coast and an inland high pressure area drops more than 7 millibars in one day. It was reported during a gale that this oil rig experienced a wave with a height of 90 to 100 feet (27.5 to 30 m).

ANNEX 4

SAR "SCOTIA CAPE" - February 7, 1987

Resources Utilized		Transit	Search	Total
442 Sqn	Buffalo 456	22.2	30.6	52.8
	Buffalo 458	14.0	51.5	65.5
	Labrador 304	5.9	51.5	57.4
	Labrador 312	4.2	39.9	44.1
407 Sqn	Aurora 101	1.5	7.1	8.6
	Aurora 117	-	9.3	9.3
	Aurora 118	4.2	5.7	9.9
VU 33 Sqn	Tracker 2157	8.6	13.5	22.1
	Tracker 2161	23.1	32.5	55.6
	Tracker 2196	15.6	31.0	46.6
435 Sqn	Hercules 334	25.3	43.5	68.8
	Hercules 335	19.7	19.6	39.3
USCG	HC130 1707	8.0	23.4	31.4
	HC130 1709	1.8	7.8	9.6
	H3 1434	1.0	7.9	8.9
	H3 1482	.9	2.1	3.0
CCG	HS61 CF-DOH	2.0	3.4	5.4
RCMP	Goose CF-MPG	-	3.0	3.0
Civil	H500 CF-IQF	-	2.8	2.8
	G21A CF-JOS		9.0	9.0
CCG Bull Harbour Lifeboat		-	5.2	5.2
CCGC Racer		3.3	53.3	56.6
CCGC Point Henry		3.9	9.0	12.9
CCGC Darby		2.9	55.3	58.2
DFO Arrow Post		3.0	10.0	13.0
Grand Totals		171.1	527.9	699.0

Total Hrs. 699.0

Total Sq. m 105,800

ANNEX 5

CANADIAN SPECIAL PUBLICATION OF FISHERIES AND AQUATIC SCIENCES 56

Oceanography

of the

British Columbia Coast

Chapter 6. Nature of Ocean Waves

Freak or giant waves occur every so often when the various randomly moving groups of waves add up, or "get into step" to produce a mountain of water. Their life is short, only a minute or two, as the waves soon get out of step again. As a consequence, they are totally unpredictable and can come out of nowhere.

In fact, statistical theory indicates that only 1 wave in 23 is twice the height of the average, 1 in 1175 is over 3 times the average, and only 1 in over 300,000 exceeds 4 times the average height. Nevertheless, freak waves 20–30 m high have been reliably recorded. One wave, recorded by

Queen Charlotte Sound and the southern end of Hecate Strait are especially vulnerable to deep-sea waves from the southwest which, when aided by favoring winds, undergo little attenuation as they propagate northward. In addition, frontal systems are known to rapidly generate steep mountainous seas over the broad shoal area adjacent to the east coast of the Queen Charlotte Islands and leave the hapless mariner no choice but to ride them out.

"The most dangerous aspect of these storms is not the magnitude of the waves generated but the rapidity with which operating conditions change from difficult to dangerous or impossible. At 1500 on October 22 the seas were reported 10 ft in height. Within 8 hr the waves were 60 ft in height and were extremely dangerous for all ship operations. Shortly after this, there was an even more rapid decrease in wave height." (James 1969). Figure 14.4 shows the wave heights reported by personnel of Southeastern Drilling and Shell of Canada, aboard the rig during the storm.

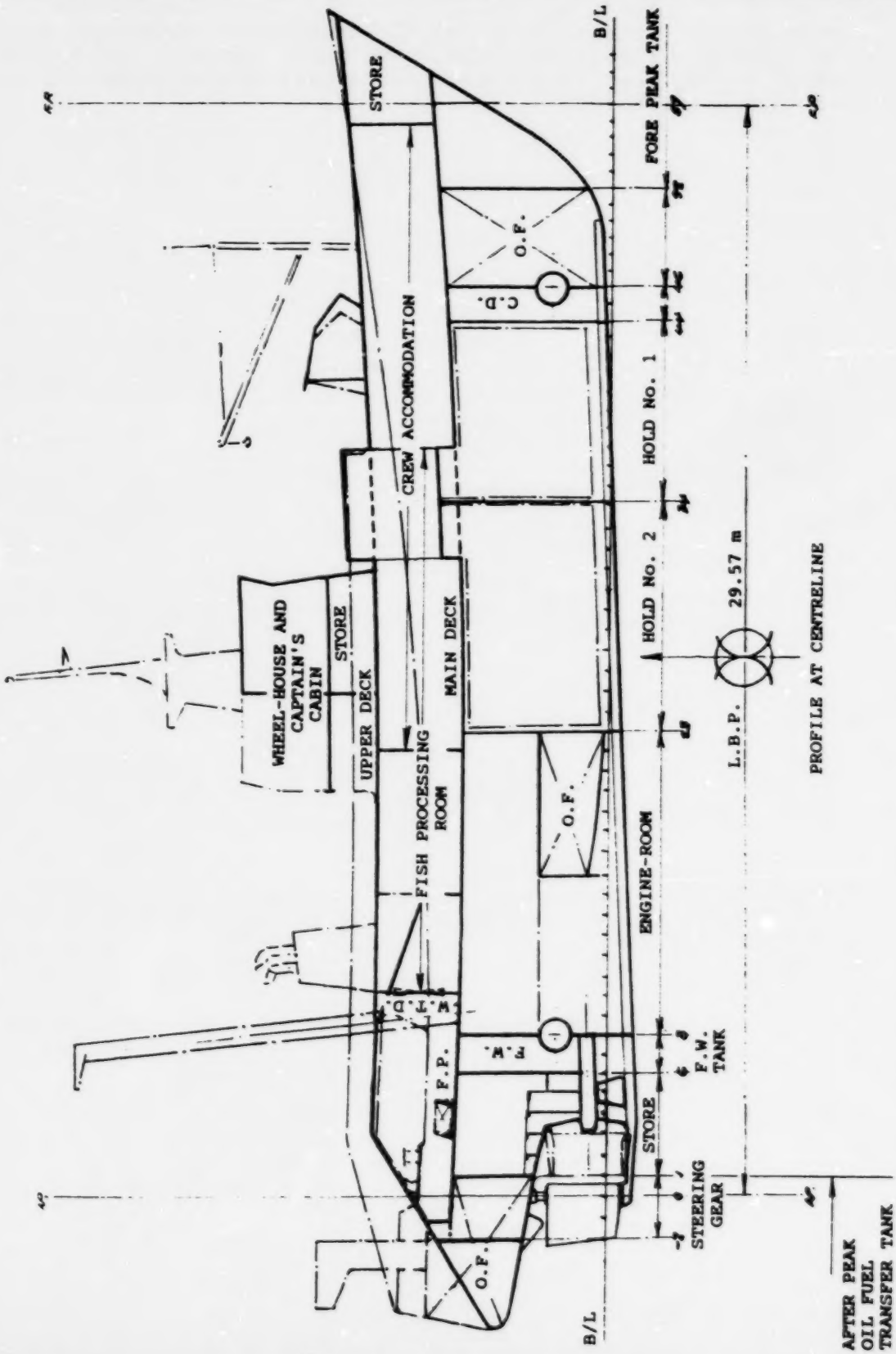
Annex 6

Post-casualty calculations prepared to illustrate the hypothetical effects on the vessel's stability that could have been brought about by the stress of the prevailing weather conditions indicate that the heeling effect of a steady 50 knots wind on the beam of the vessel as she was loaded on arrival at the fishing grounds, would have caused a steady heel of about 10°, and that she would lurch to some 25° in sudden gusts. When held over at a steady heel of 10° by the wind, the main deck edge is immersed approximately 155 mm (6 in), and the vessel's effective reserve transverse stability is reduced. The subsequent free-surface effect of water shipped and retained on deck, together with the transverse heeling moment caused by the liquids in the slack tanks gravitating to the lower side of the heeled vessel, would further reduce the already low transverse stability until it became marginal, and, in the event, insufficient to withstand the dynamic effects imposed by the prevailing weather conditions. Figure I, graphically illustrates this progressive reduction of the vessel's ability to recover. Upon departure the vessel's maximum righting lever (GZ) was calculated to be 0.13 m (0.43 ft), and after approximately 30 hours steaming, 0.113 m (0.37 ft). Under the influence of 50 or 70 knots beam winds, the maximum remaining effective righting levers would have become 0.052 m (0.17 ft), or 0.023 m (0.076 ft). These progressively reduced righting levers are respectively only 65%, 56.5%, 26% and 11.5% of the regulatory minimum requirement (0.2 m) (0.66 ft) of STAB 4. The shaded areas under the stability curves also show how, on arrival at the grounds, the dynamic stability at 40° heel was only 65% of the regulatory minimum requirement, and that due to the steady heeling effect of a 50 knot beam wind, this was effectively reduced to just 20%. These stability characteristics are based upon an ideal 'static' sea state; in actual sea conditions angles of roll are usually greater than calculated, and because of the interacting effects of winds, waves, vessel speed and attitude, the reserve dynamic stability of relatively small vessels is subject to considerable fluctuation.

By way of comparison and in order to provide a clearer perspective of this casualty, two further alternative and hypothetical loading conditions were prepared; one, showing the vessel after 40 hours fishing, assuming she had caught and loaded 16% of a full catch, and the other, for the vessel on arrival at the fishing grounds, assuming she had sailed without any fuel oil in the after peak oil fuel transfer tank. Figures II and III graphically illustrate how the statical and dynamic stability characteristics of the vessel, while in these hypothetical loading conditions, were capable of safely absorbing the additional stresses imposed by the prevailing wind and sea states reported in the area of the fishing grounds. Furthermore, additional calculations taking

into account the effects of 70 knot winds, show that while her reserve stability would have been reduced, the "SCOTIA CAPE" would most likely have still retained adequate margins to ensure her safety.

F.V. "SCOTIA CAPE"
OUTLINE GENERAL ARRANGEMENT



4 X 1A.
MARINE CASUALTIES
INVESTIGATIONS.

FIGURE I.

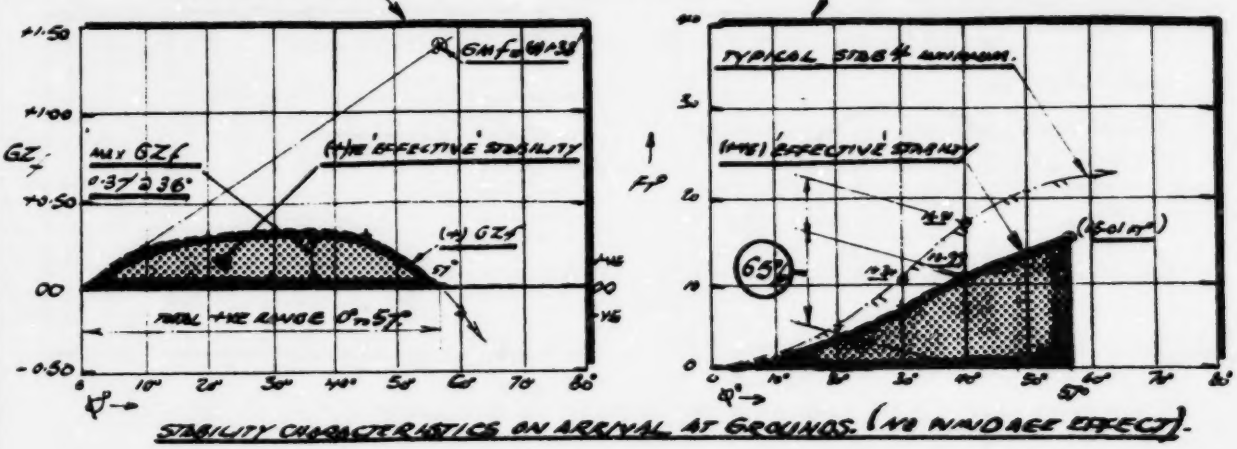
DATE:-

F.V. 'SCOTIA CAPE'.

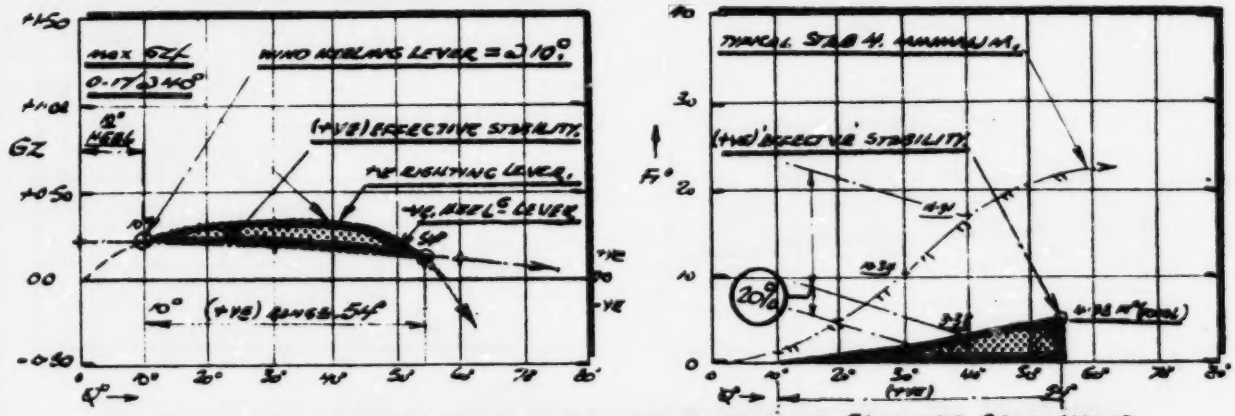
PROGRESSIVE REDUCTION OF TRANSVERSE STABILITY CHARACTERISTICS AND COMPARISON WITH MINIMUM CRITERIA OF STAB 4.

(VESSELS REPORTED DEPARTURE CONDITION, WITH 65 TONS ICE IN HOLDS, AND AFT PEAK TANK 400 CU. FT. 85% FULL)

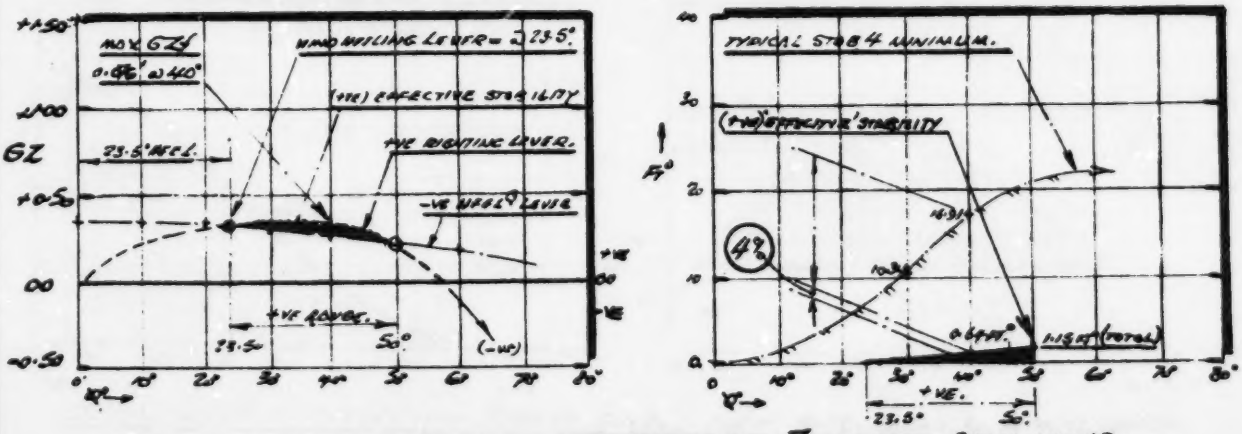
STATICAL STABILITY — CONDITION No 2A — DYNAMIC STABILITY



STABILITY CHARACTERISTICS ON ARRIVAL AT GROUNDS. (NO WINDAGE EFFECT).



STABILITY ON ARRIVAL AT GROUNDS, WITH EFFECT OF 50 KNOTS BEAM WIND.



STABILITY ON ARRIVAL AT GROUNDS, WITH EFFECT OF 70.0 KNOTS BEAM WIND.

AXIA.
MARINE CASUALTIES
INVESTIGATIONS.

FIGURE II.

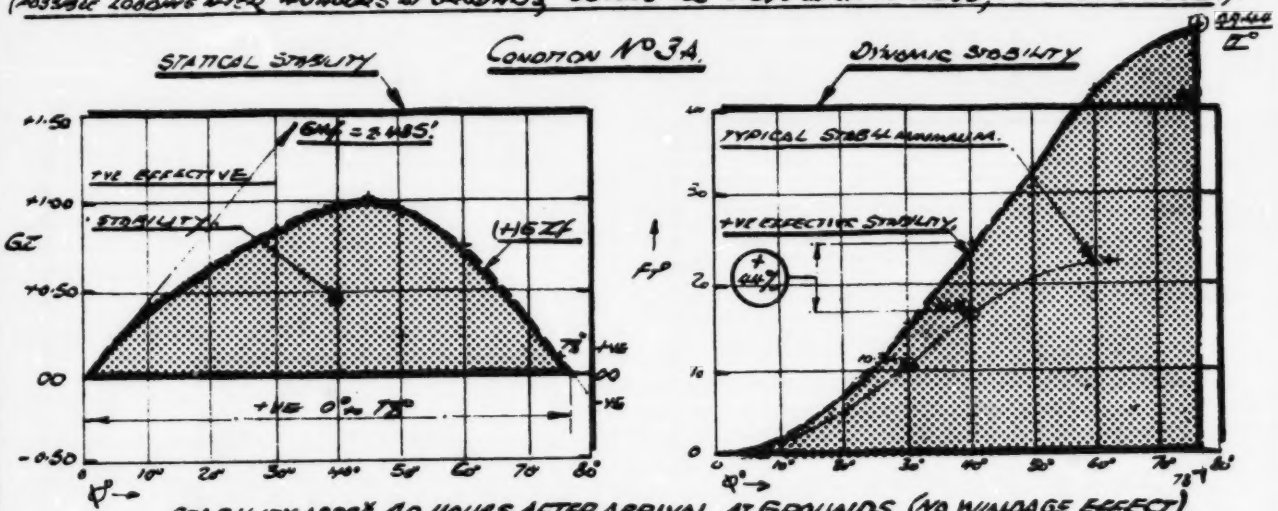
DATE:-

F.V. "SCOTIA CAPE".

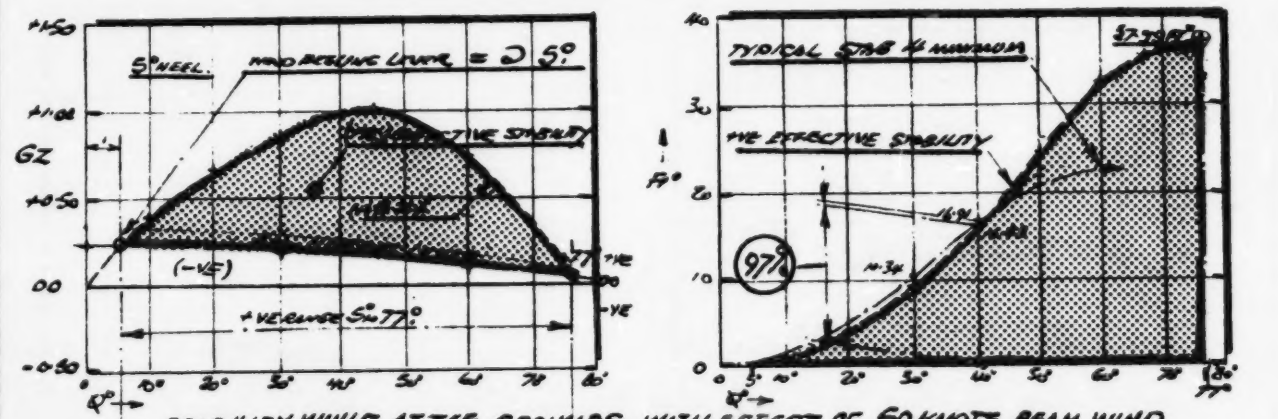
PROGRESSIVE REDUCTION OF TRANSVERSE STABILITY CHARACTERISTICS AND COMPARISON WITH MINIMUM CRITERIA OF STAB 4.

(POSSIBLE LOADING AFTER 40 HOURS AT GROUNDS, 65 TONS ICE & 16% CATCH IN HOLDS, & A.P. TANK IN USE.)

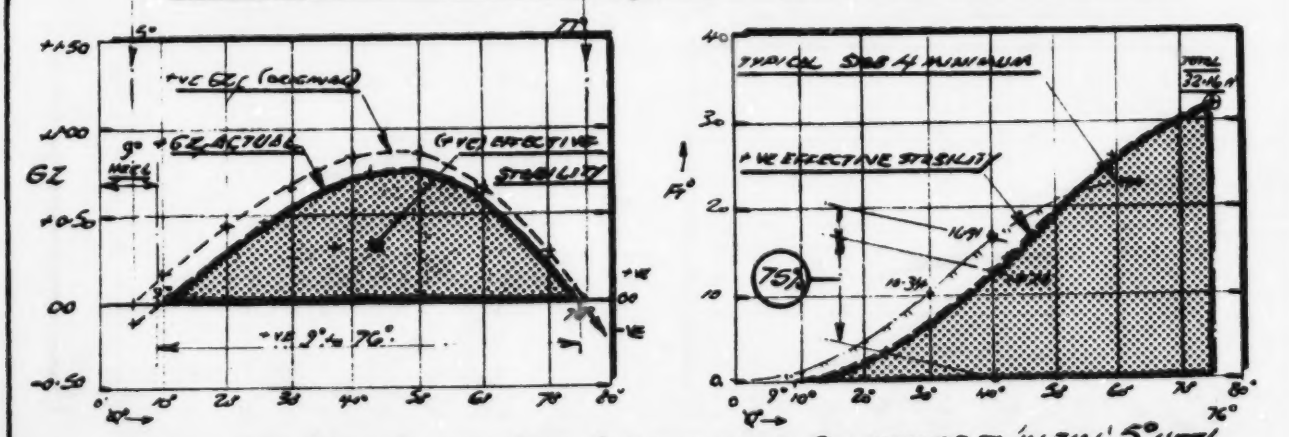
CONDITION No 3A.



STABILITY APPRX 40 HOURS AFTER ARRIVAL AT GROUNDS (NO WINDAGE EFFECT).



STABILITY WHILE AT THE GROUNDS, WITH EFFECT OF 50 KNOTS BEAM WIND.



STABILITY WITH 50 KNOTS BEAM WIND, & SLACK TANKS GRAVITATED TO 'INITIAL' 5° HEEL.

4 X 1 A.
MARINE CASUALTIES INVESTIGATIONS.

FIGURE III.

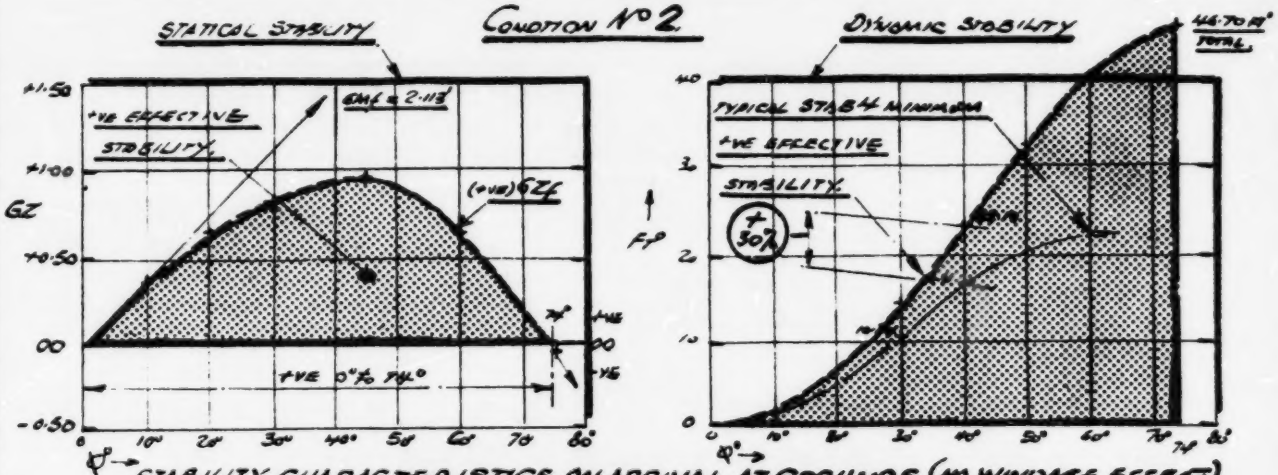
DATE:-

F.V. 'SCOTIA CAPE'.

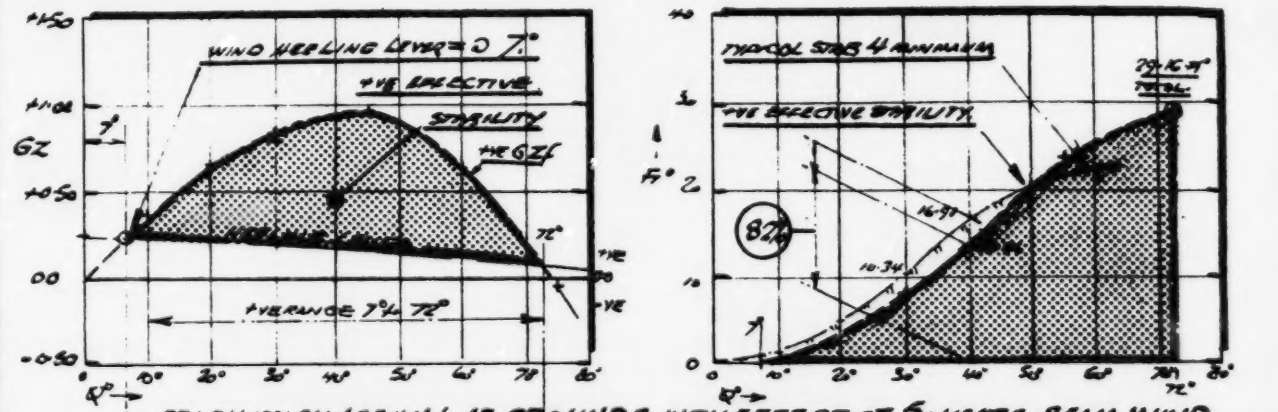
PROGRESSIVE REDUCTION OF TRANSVERSE STABILITY CHARACTERISTICS AND COMPARISON WITH MINIMUM CRITERIA OF STAB 4.

(HYPOTHETICAL LOADING CONDITION ON ARRIVAL AT GROUNDS, WITH 65 TONS ICE IN HOLDS, A.P. TANK EMPTY).

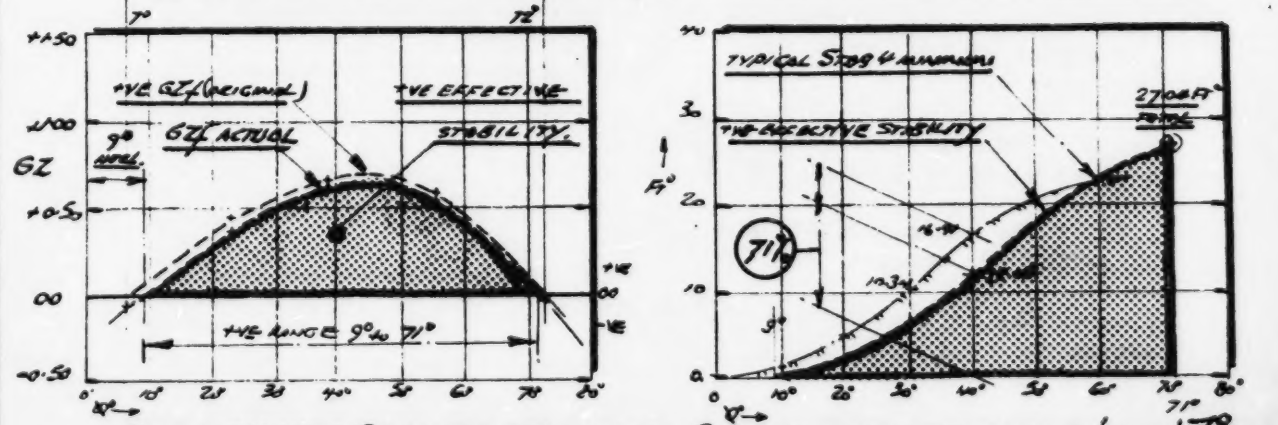
CONDITION No 2.



STABILITY CHARACTERISTICS ON ARRIVAL AT GROUNDS (NO WINDAGE EFFECT)



STABILITY ON ARRIVAL AT GROUNDS, WITH EFFECT OF 50 KNOTS BEAM WIND.



STABILITY WITH 50 KNOTS BEAM WIND, & SLACK TANKS GRAVITATED TO 'INITIAL' HEEL.

ANNEX 8

STABILITY, SUBDIVISION, AND

LOAD LINE STANDARDS

INTRODUCTION

The standards outlined in this booklet have been developed by the Board of Steamship Inspection, Department of Transport, and indicate conditions of approval and criteria used by the approval authority in assessing submissions required by regulations written under the Canada Shipping Act.

The criteria outlined in the various standards denote minimum requirements with no maximum limits having been set. The standards are intended to supplement the regulations in matters of detail to ensure uniform minimums across the country and to give a base from which shipowners, shipbuilders, and designers may work.

STANDARD: STAB 4

STABILITY STANDARDS FOR FISHING VESSELS:

(a) subject to compliance with the Large Fishing Vessel Inspection Regulations, or

(b) required to submit stability data by the Small Fishing Vessel Inspection Regulations.

OPERATING CONDITIONS WITH NO ACCUMULATED ICE

1 The following minimum intact stability criteria are to be used in the approval of stability data for the above vessels:

(i) The area under the righting lever (GZ) curve should not be less than 0.055 metre-radians up to $\phi = 30°$ angle of heel, and not less than 0.09 metre-radians up to $\phi = 40°$, or the angle or downflooding ϕ_f if this angle is less than 40°.

Additionally, the area under the righting lever (GZ) curve between the angles of heel of 30° and 40° or between 30° and 0_f if this angle is less than 40°, should not be less than 0.03 metre-radians.

(ii) The righting lever GZ should be at least 0.20 metres at an angle of heel equal to or greater than 30°.

(iii) The maximum righting arm should occur at an angle of heel preferably exceeding 30° but not less than 25°.

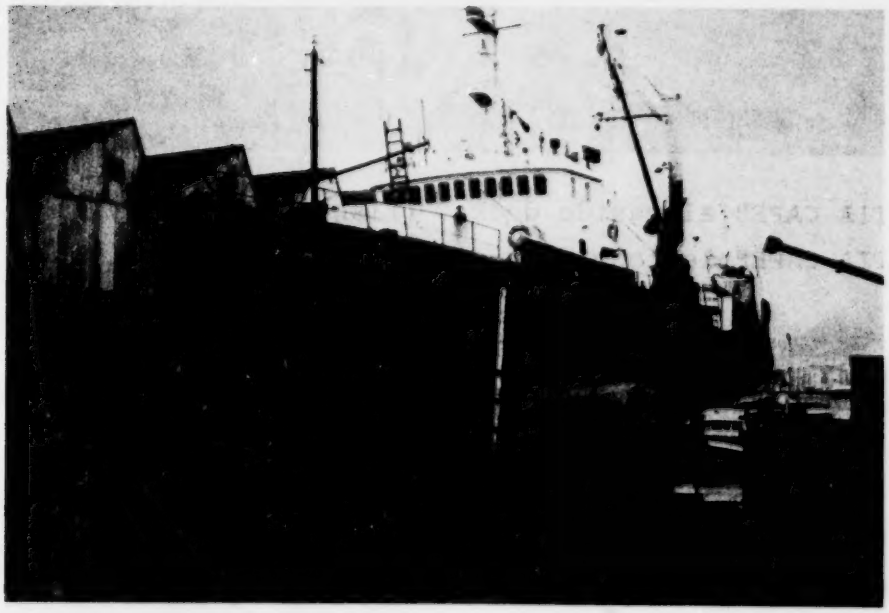
(iv) The initial metacentric height(GM) should not be less than 0.35 metres.

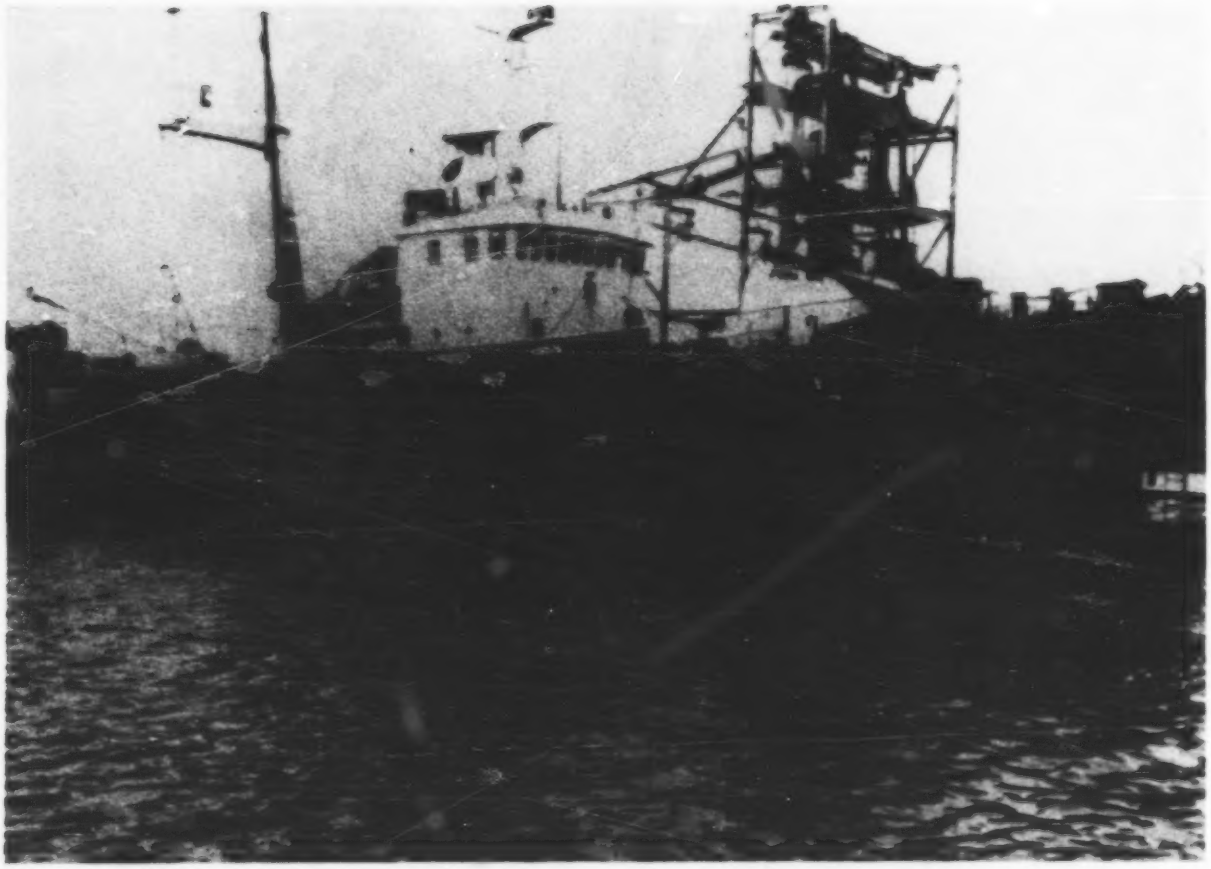
3 Hydrostatic and stability curves should normally be prepared on a designed trim basis. However, where the operating trim or the form and arrangement of the ship are such that change in trim has an appreciable effect on righting arms, such change of trim is to be taken into account.

7 In cases where a ship would flood through an opening, the stability curve is to be cut short at the corresponding angle of flooding and the ship is to be considered as having entirely lost her stability at that angle.

F/V "SCOTIA CAPE"

B.P. "SCOTIA CAPE"





"SCOTIA CAPE" alongside dock. (fish holds empty)
"SCOTIA CAPE" le long du quai. (cales à poisson vides)

"SCOTIA CAPE" aground in 1985. "SCOTIA CAPE" échoué en 1985.

Opened net with fish on upper deck on "SCOTIA BAY". (sister ship to "SCOTIA CAPE")

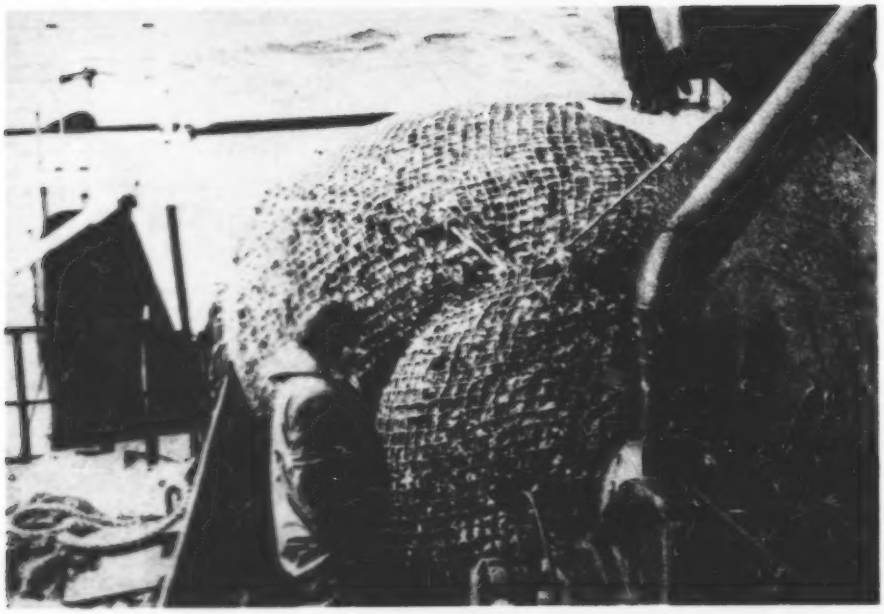
Filet ouvert avec prise sur pont supérieur à bord du "SCOTIA BAY". (navire jumeau du "SCOTIA CAPE")

"SCOTIA CAPE" aground in 1985.

"SCOTIA CAPE" échoué en 1985.

Hauling in a net full of fish on board the "SCOTIA CAPE".

Rentrée à bord d'un filet plein de poissons à bord du "SCOTIA CAPE".

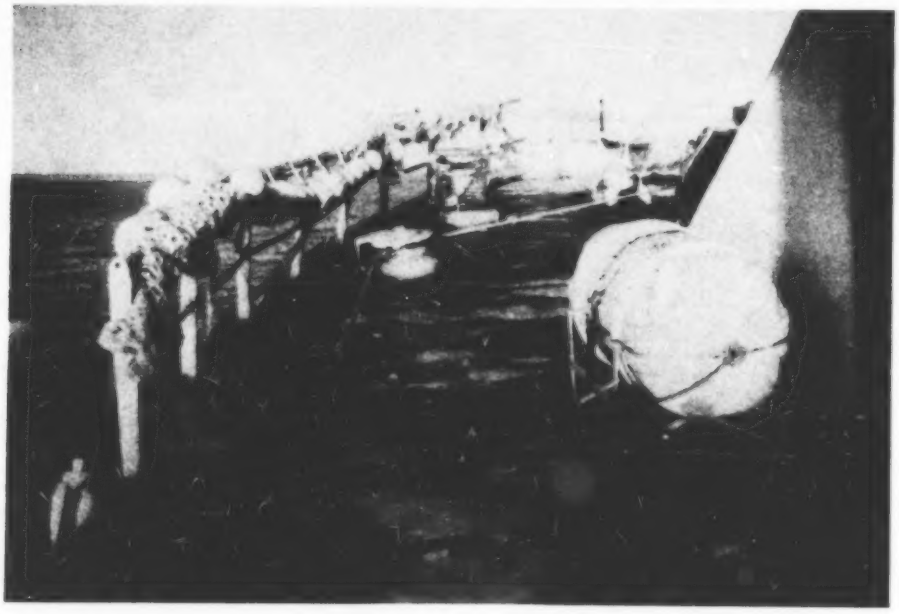


Large catch of fish (approximately 18 tonnes) on upper deck of "SCOTIA CAPE".

Une grande prise de poissons (approximativement 18 tonnes) sur le pont supérieur du "SCOTIA CAPE".

"TENACITY I" fishing control station on starboard side.

Poste de commande pour la pêche sur tribord à bord du "TENACITY I".



"SCOTIA CAPE" port side showing lashings on liferaft.

Démontre assujettissement du radeau de sauvetage sur bâbord- "SCOTIA CAPE".

"TENACITY I" ex: "SCOTIA POINT"

"TENACITY I" jadis "SCOTIA POINT"

Sister ship to "SCOTIA CAPE" now refitted for scallop dragging.

Navire jumeau du "SCOTIA CAPE" armé pour la drague à pétoncles.

Wheel-house of "TENACITY I" fish finding equipment and control station on starboard side.

Timonerie du "TENACITY I" équipement de repérage de poisson et poste de commande sur tribord.